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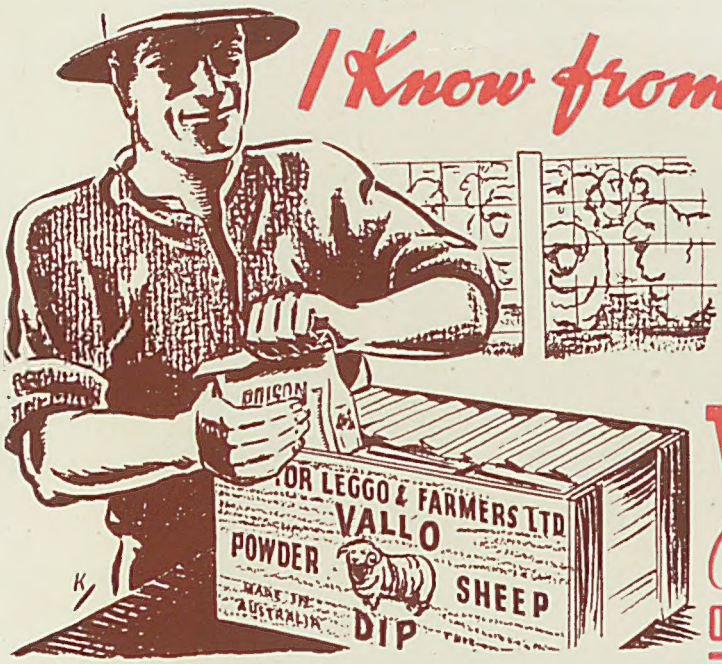

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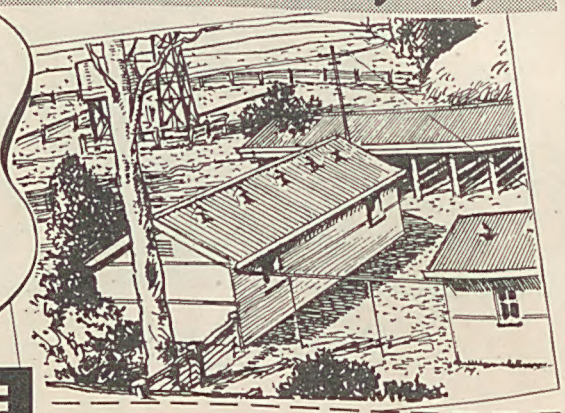

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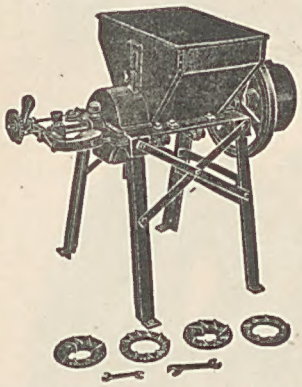

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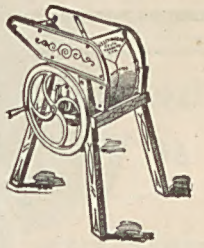

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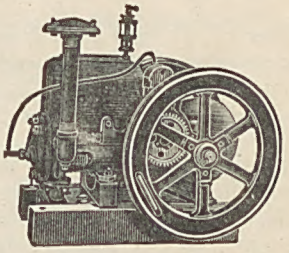

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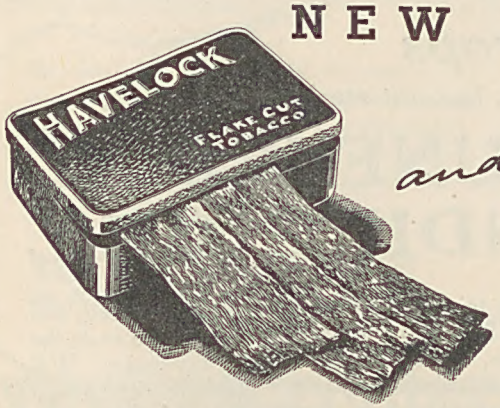

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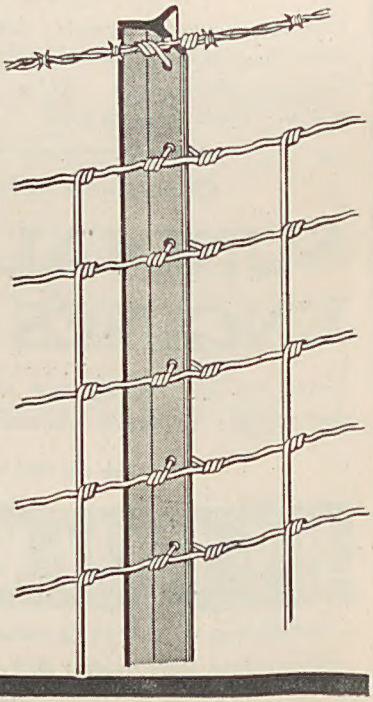

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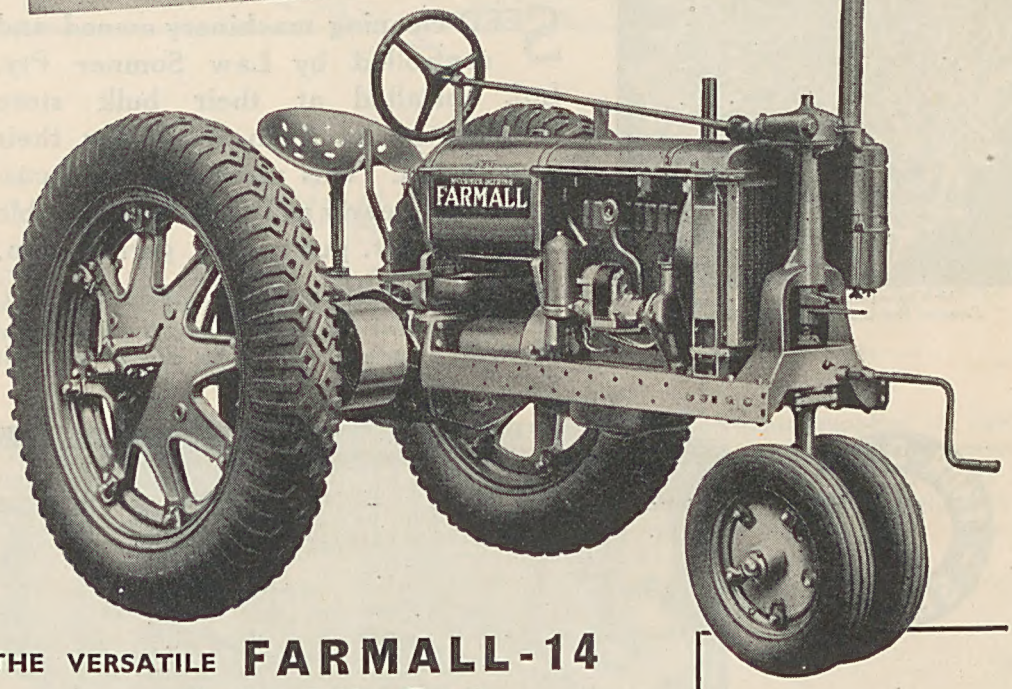

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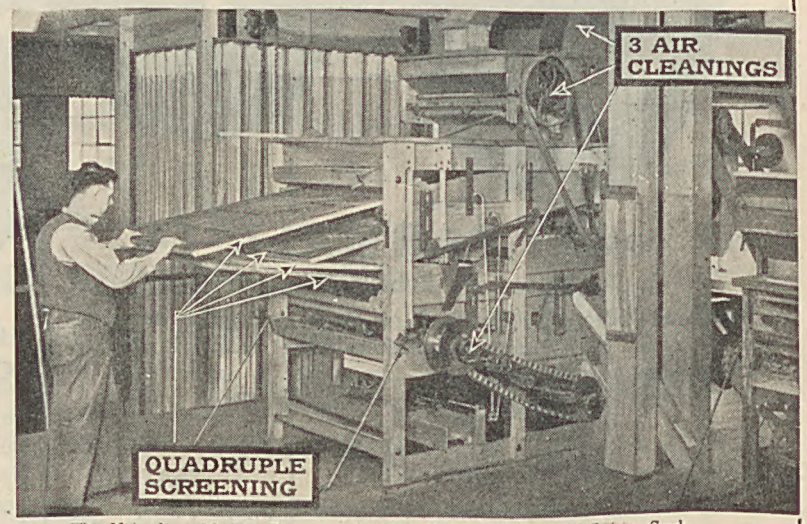

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Journal of Agriculture, Victoria—December, 1939.

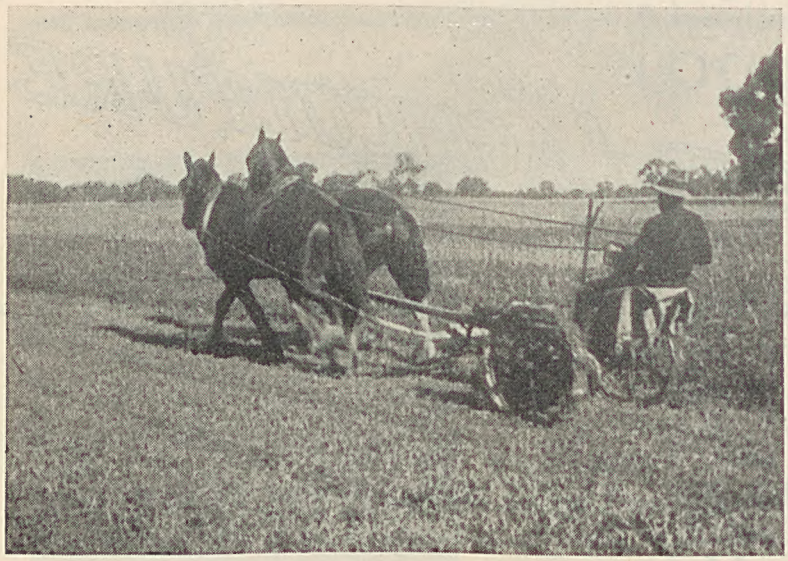
Conserving Surplus Pasture

Silage and Hay Making from Subterranean Clover

By J. A. Morrow, B. Agr.Sc., Manager, Rutherglen Experiment Farm

TO those farmers whose incomes are largely dependent upon the sale of livestock or animal products, the utilization of their pastures to best advantage is of major importance, and it is essential that adequate supplies of feed be available at all times if maximum returns are desired. The requirements vary with the type of stock raising undertaken, but whatever the activities, this season presents a unique

Heavy growth of clover pasture at Rutherglen Experiment Farm. Two hundred acres of such surplus growth is being conserved as silage or pasture hay.



Mowing clover pasture at Rutherglen.

opportunity for the conservation of sufficient fodder to maintain production over several lean seasons, and for supplementary feeding when necessary.

In many parts of Victoria the rainfall received this season has exceeded the previous record by several inches. This has resulted in such phenomenal growth of pastures that utilization by grazing has been impracticable. To avoid wastage and to spread out the good season to cover possible shortage in ensuing years, some form of fodder conservation should be undertaken before deterioration of the pastures occurs.

The surplus growth may be conserved either in the form of silage or as meadow hay, each of which has its advantages and disadvantages. The choice of what method is to be adopted will depend largely on the type and stage of growth of the material, weather conditions, facilities for storage and handling, and the purpose for which the reserves are made.

Silage, though not equal in food value to fresh green fodder, is a very good substitute, and is valuable in providing succulent fodder for stock in periods when other green feed is not available. It can be made early in the season from immature growth before hay making is desirable because of uncertain weather, or for other reasons. By commencing fodder conservation with silage early in the season and changing to hay making as the pasture matures and wet weather risks decrease, the maximum reserve can be built up with the equipment available.

Pastures which are infested with weeds, the seeds of which are liable to spread in hay, may be safely made into silage, and, as a general rule, it may be taken that poor quality material will give better results as silage than as hay.

Storing Silage.

Silage is generally stored in pits or trenches, but may also be made in stacks or overhead silos. The pit or trench usually consists of an excavation to a depth of from 6 to 8 feet, but may be of any shape or size. The walls may be either vertical or with a slight slope. For ease of filling and emptying, it is desirable to make a rectangular excavation of sufficient width to allow the implements used in the making to pass freely along the trench. This also enables consolidation to be more effectively

A sweep on the way to the silage stack.

Two stacks in their early stages. Four sweeps are used to bring the cut growth to the stack.

carried out by horses and vehicles which may be continually driven over the material. This point is important in that it is necessary to have the air excluded as rapidly as possible for best quality silage. It is desirable to have the trench filled rapidly to prevent too great a rise in temperature and consequent loss of food value. Temperatures should not rise much above 130°F., and rapid filling is normally required to keep the temperatures within reasonable limits. Although palatable and useful silage may result without taking care to control the fermentation, the highest quality material will not result from haphazard methods.

In exceptional circumstances where the material is very succulent and the water content very high, it may be desirable to allow the material to wilt a little before ensiling, or if conditions do not permit this, a slower rate of filling could be adopted. Cases where these precautions are necessary in the spring are uncommon.

The trench should be filled above ground level to a height about equal to its depth. If the material has been trampled during filling this should settle down so that the finished silage will be far enough above ground level to prevent water lodging on the top. On completion of filling the whole of the surface should be covered with soil to protect the silage from the air. The amount of soil required will vary from about 9 to 12 inches for heavy soils to greater amounts for soils of more open textures. Sometimes considerable settling occurs after covering and cracks appear in the soil. This may be readily repaired by harrowing the surface.

A trench 14 feet wide and filled to a total depth of 8 feet will hold approximately 2 tons of silage per foot length of the trench. If the trench is made by cutting into a hillside, leaving a slight slope on the floor, filling and emptying will be simplified and the trench will drain automatically. It is most important to select such a site if it is available in a convenient position.

For stack silage adequate trampling is not practicable, and exclusion of the air must be achieved by rapid filling or building and frequent topping-off of the stack. To obtain best results some form of elevating machinery such as the grab-stacker is desirable, and in order to obtain maximum pressure in the shortest time the size of the stack base should not be too large. On the small farm with limited labour and machinery, height in a large stack cannot be obtained as quickly as in a small one, and consequently exclusion of air by pressure is a slower process. On the other hand the smaller the stack the greater is the percentage of material exposed to the air, and the greater

the proportion of loss from this cause. It is necessary therefore to compromise on the size of the stack according to the amount and type of equipment available. A stack with a diameter of about 20 feet would not give an unduly high wastage percentage, and can be filled or built sufficiently rapidly to produce good silage, particularly if a grab-stacker is used.

The process of silage making is dependent on bacterial action, and it frequently happens that on the shady or windward side of the stack this action is retarded in comparison with the other side and the stack may settle unevenly, and in some cases slip badly. To prevent this it is desirable to erect poles on the boundary of the stack base—three or four poles equally spaced are generally sufficient.

Wastage on the exposed portions of stack silage is often considerable. This is caused partly by exposure to the weather and partly by the fact that sufficient consolidation to exclude the air during the period of actual silage making cannot be obtained in the absence of tramping right to the edge of the stack. This may be overcome to a great extent by building the stack inside a "former" or temporary frame, and the process becomes similar to filling an overhead silo. The chief object of the "former" is to obtain consolidation to the edge of the stack, and since this is done as the silage is being made it may be removed when the stack is completed and used again for the next stack. This "former" is really a temporary silo, and if made in sections can be quickly dismantled and re-erected.

Temporary silos which achieve the same purpose, and in addition give protection from the weather for some years, may also be erected. Materials for silos of this type are produced commercially, and if instructions are followed no difficulties are likely to be experienced in either erection or filling.

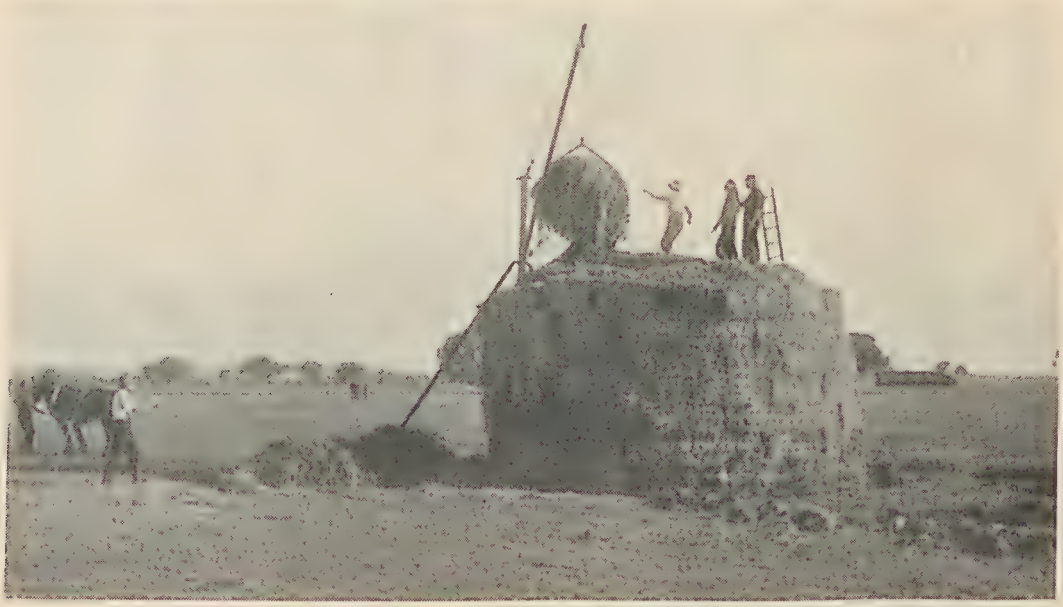
An effective silo can also be made of baled straw or baled meadow hay, provided that certain precautions are taken. A level piece of ground should be chosen and a wall built, after the style of a brick wall. The wall need only be one bale thick, but it is necessary to have the bales held in position by twitching a piece of wire around each layer. The binding wire should be left comparatively loose until considerable pressure is obtained inside the silo. If the wire is too tight the bales will be dragged out of position. Later they should be kept as tight as possible. To facilitate filling, erection of the wall should be kept just ahead of the filling. Though guiding poles are not absolutely necessary, there is a danger of a certain amount of sideslip, and two or three poles are desirable.

For minimum wastage the stacks should be circular. When stacking is completed the dome-shaped top should be weighted down. This is generally done by covering the top with earth, but it can be a rather expensive and laborious process, and if the material is plentiful it may be cheaper to increase the height of the stack by a couple of feet and obtain the necessary weight with posts or sleepers.

Meadow Hay.

The harvesting of meadow hay may be commenced as soon as weather conditions permit curing, and continued until lodging makes mowing difficult. Better quality hay will be obtained from the immature growth. As the

Stacks nearing completion.



A stack of silage enclosed by a wall of straw-bales. The grab stacker is used to lift the pasture on to the stacks.

pasture dries off the quality deteriorates, because of development of fibre and objectionable characteristics of some of the annual species. If much hay is to be harvested it is desirable to cut as much as possible before wilting commences. Curing will take longer in the early stages, and the crop should not be stacked until sufficiently dry to prevent moulds developing or the stack firing. If left in the paddock too long, much of the leaf of such species as subterranean clover will be lost, and it is desirable to commence stacking as soon as the material is sufficiently cured. As the season progresses and the weather becomes warmer the time taken for curing decreases and stacking may be carried out very soon after cutting.

The hay may be stacked loose or baled, the latter method having a great advantage where it is desired to store or feed the hay in other paddocks. As with silage, the hay can be handled cheaply and effectively with sweeps and a grab stacker. For economical handling, the distance the material is swept should be limited to a maximum of 6 or 7 chains and the size of the stacks arranged accordingly.

Silage or Meadow Hay?

Silage has advantages over meadow hay in that the risk from fire is negligible in stacks and absent in trenches, and fencing is unnecessary. The fodder is conserved in a succulent condition and conforms more closely to the characteristics of green herbage. In trenches it may be stored indefinitely without deterioration, but in small stacks its "life" is more limited. It may be made when weather conditions prevent haymaking, and it provides an excellent method of reducing the amount of undesirable weeds in the pasture. Early cutting also permits a fresh growth or aftermath of pasture in most seasons.

On the other hand handling of silage involves transport of much larger weight than does an equivalent value of meadow hay. When opening the trench or stack the area of fresh silage exposed should be as small as possible and only sufficient silage taken out each day for one day's feeding, otherwise wastage and loss in food value will occur.

The normal unavoidable loss from a stack is considerable, but is reduced to a minimum in pits or trenches. As a general rule it may be taken that if storage for several years is required, it would be desirable to have silage stored in pits and trenches, and the stacks limited to what would be required in the near future. If it is not practicable to have pits where required, and pasture growth is heavy and of good quality, storage as meadow hay should be given preference, and risks taken regarding weather damage during curing.

A silage stack ten days after completion. (In this case no special weights on top were used.)

Tests at Rutherglen.

At the Experiment Farm, Rutherglen, abnormally heavy pasture growth occurred this year, the weights of fresh greenstuff per acre varying from 13 to 15 tons in a pasture consisting of almost 95 per cent. subterranean clover (this paddock produced heavy cereal crops in 1937 and 1938 and was allowed to revert to pasture this year). In another paddock consisting of about 70 per cent. subterranean clover and some annual grasses and *Erodium botrys* an average of about 20 tons per acre was obtained.

To make best use of the surplus growth and to obtain information regarding methods of silage and hay making a series of experimental stacks and trenches was commenced on 11th October (weather conditions did not permit an earlier start).

Pasture silage has been successfully made at Rutherglen in previous years, and the object of these experiments in silage making is to determine the effects on the product of the—

(1) Rate of filling or stacking.
(2) Addition of molasses during ensiling, which practice is recommended when making silage from clover pastures overseas.
(3) Degree of maturity of the pasture ensiled.
(4) Percentage of clover in the pasture.
(5) Storage in pits as compared with open stacks or temporary overhead silos.
(6) Shape and size of stacks.
(7) Weighting or otherwise of the finished stacks.
(8) The temperatures during fermentation as a result of the above practices.

Stacks were erected rapidly or slowly according to plan, the slow fill being approximately half the rate of the quick fill which was taken as the maximum amount which could be stacked using a grab stacker and sufficient sweeps to maintain continuous stacking. These stacks were 18 ft. in diameter, and contained approximately 50 to 60 tons, estimated at 40 to 45 lb. per cubic foot. In other stacks of similar size and filled at similar rates, molasses was added at rates varying from 2½ to 4 gallons per ton of greenstuff. The temporary overhead silos consisted of one erected with baled straw, and one of the material mentioned previously, each being of similar size to the open stacks.

Analyses of the material as ensiled have been made and will be repeated when the stacks or pits are opened. Temperatures have been taken three times each day in various positions in each stack. The temperature has been found to vary considerably with the position of the

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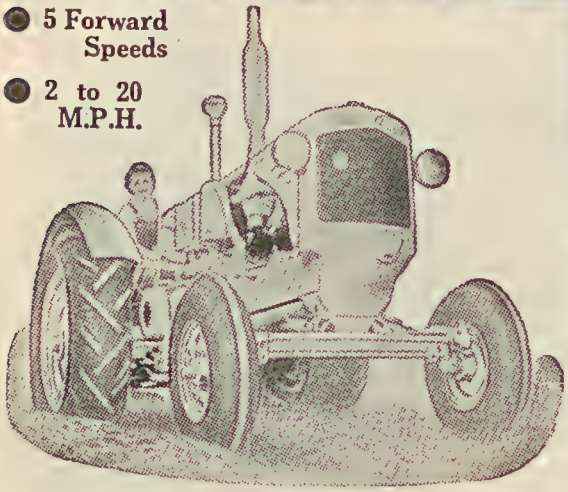

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thermometers, but it has been found that the larger and slowly filled stacks generated more heat than the rapidly built stacks. The temperatures in the enclosed silage were more uniform.

Where molasses was added the temperatures were maintained at a lower level, but the significance of this is not fully understood. A full report on these experiments will be furnished when the results are complete.

The equipment used in making the silage consisted of one mower, four farm-made one-horse sweeps, and a grab stacker. In the short range work near the stack two sweeps have been sufficient to keep the material up to the stacker, but as the distance became greater the other sweeps were required. The mower was not required for full time, and by arranging the cutting it was possible for the driver to take a sweep when necessary.

The cost of erecting the stacks, including all operations, moves from site to site, erection of poles, &c., with wages at 13s. per day per man, was approximately 6s. 6d. per ton of pasture ensiled. It is estimated that for trenches which require less labour and transfer of equipment, &c., this cost could be reduced to below 5s. per ton, excluding the cost of pit-making.

Meadow hay costs more per ton to stack, but owing to the lower moisture content the cost is actually less per unit of food value. The costs will vary considerably with the density of pasture growth and the facilities for handling, but there is little doubt that this season presents an opportunity for fodder conservation, either as silage or hay, which, for quality and quantity of fodder and economy of handling expenses, is not likely to be experienced again for many years.

The Stock Medicines Act

Prosecution for Offence

The first case under the *Stock Medicines Act* 1937, was heard at the Parhran Court of Petty Sessions on the 10th of November, 1939, before Mr. J. Meehan, Police Magistrate, when Stanley Cochrane, of 1A Centreway, Chapel-street, Prahran, was charged with—

(*a*) selling an unregistered stock medicine; and

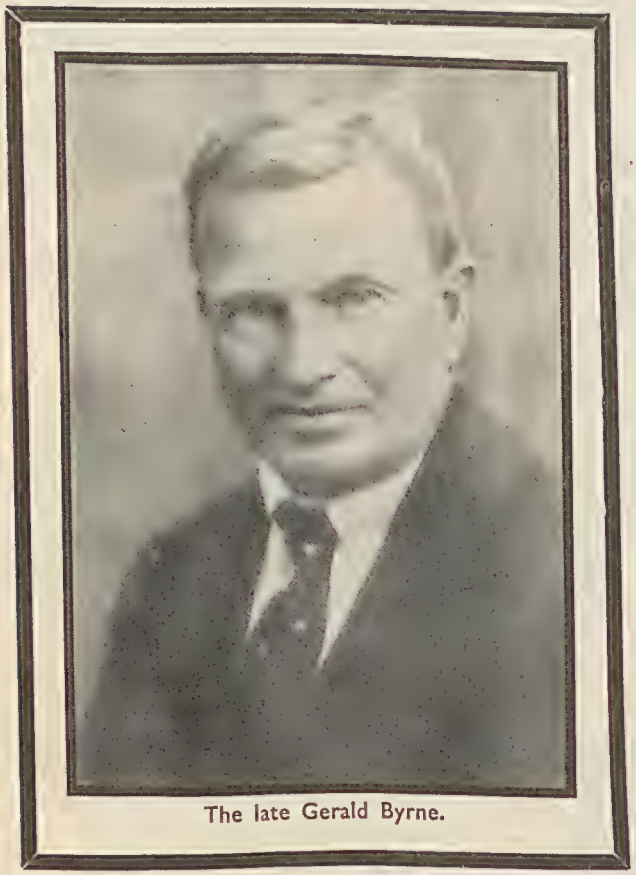
(*b*) selling under the name of a registered stock medicine, a medicine which did not conform with the registered prescription or composition of such registered stock medicine—

contrary to the provisions of section 10(*a*) and 10(*b*) of the Act, respectively.

Cochrane, who is the proprietor of Eureka Mineral Foods, was found guilty and fined £1 on each charge, and was ordered to pay £4 4s. costs.

In the first charge, evidence was produced that the preparation "Eureka Mineral Food, Worm Cure, and Tonic No. 1" was not registered under the Act. In the second charge, evidence was submited by an analyst of the Department of Agriculture that analysis of the sample taken of the preparation "Eureka Mineral Poultry Food Tonic No. 2" showed that the mixture did not conform with the registered prescription or composition submitted by the defendant in his application for registration.

The case for the prosecution was conducted by Mr. K. Anderson of the Crown Law Department. Mr. N. Mitchell, instructed by Messrs. Coy and England, appeared for the defendant.



The late Gerald Byrne.

Obituary

It is with regret that we announce the death of Mr. M. G. Byrne (59 years), who for the past 23 years was Editor of the Victorian Journal of Agriculture. He was well known in literary circles and was a writer of distinction in both prose and verse. His wide range of interests is evidenced by his active association with such organisations as the Australian Literature Society, The Historical Society of Victoria, The P.E.N. Club, The Y Club, The Melbourne Walking Club, &c.

Because of his pleasing personality, his kind and generous disposition, and his ever readiness to assist others, Mr. Byrne was held in the highest esteem, not only by his fellow officers of the Department of Agriculture but also by all with whom he came in contact. They all feel a keen sense of personal loss in his passing but he has left behind him the memory of a life characterized by

"little, nameless, unremembered acts
Of kindness and of love"

An Appreciation

I think everyone liked Gerald Byrne, and in saying that I understate the esteem in which he was held by those who knew him well. A great group of men loved him for the natural kindness of his disposition, the generosity of his outlook and a charity which made no display.

I knew him first as a fellow public servant, then as a bush walker—a strange sort of bush walker, for he preferred to be alone in his ramblings. It was all the more strange when he could confide to me, as he did, that he could not bear to be solitary in a camp overnight. His vivid imagination peopled the dark with strange shapes; a sudden noise would terrify him for the moment, even in daylight, so keen were his sensibilities.

In the Melbourne Walking Club, which he eventually joined, he found congenial companionship and he shared with his fellow members not only the ordinary week-end excursions but many lengthy trips about Victoria. These he enjoyed thoroughly, giving in return a friendship which made him probably the most popular member of any party. A characteristic adventure was his walk, early this year, from Melbourne to Sydney. Occasionally on this he hitch-hiked. It will always be a regret that he did not publish an account of the tour, for he made many pleasant contacts.

Gerald served the Walking Club well. At the time of his death he was a Vice-President. He had been editor of the Club's annual "The Melbourne Walker" from the birth of that attractive journal.

He could write a good article and had a nice touch in verse. His work has appeared in many papers and was known not only in Victoria. On the day he was buried he was announced as the joint-winner of the prize awarded by the Henry Lawson Society for an essay on Mary Gilmore, the well-known author.

I use no mere conventional phrase when I say that Gerald Byrne will be sorely missed. The gathering at his grave showed the wide range of his interests and what his death meant to his circle. Of his pensioners I shall say nothing save that he alone knew their number. Truly

"The actions of the just
Smell sweet and blossom in the dust."

R. H. CROLL.

Harvesting apples in a Victorian orchard.

Victorian Fresh Fruit

Exports to the United Kingdom

The following report was prepared by Mr. S. R. McColl, Commercial Officer of the Trade Branch of the London Office of the Agent General for Victoria.

IN reviewing the exports of Victorian fresh fruit to the United Kingdom during the 1939 season one is not unmindful of the many difficulties which growers encountered during a winter and summer of unparalleled dryness, culminating in the fiercest heat on record, and subsequent devastating bush fires throughout the country. These adverse conditions considerably reduced the quantity of fruit available for export, and also resulted in the export of a greater percentage of lower grade fruit, from the standard of both size and blemish, than would occur in a normal year of production.

United Kingdom buyers and distributors of Australian apples and pears also understood the great difficulties which Victorian growers met in producing a crop in such an adverse season, and were not unwilling to overlook instances in which the pack had not quite met regulation standards. There were, however, far too many packs of defective fruit, both in condition and quality, and too great a percentage of very small fruit to make the position of the wholesale distributor a happy one in any circumstances. Small sizes of pears, for instance, were always a difficult trade, and had to be sold at low values.

However, the following comments on condition, quality, grading, and packing have been prepared with a view to recording the outturn in this unfavorable export season, and are the result of personal inspections carried out by the Superintendent of Horticulture, Mr. J. M. Ward (who has just returned to Victoria from abroad), and myself at the docks and markets in London, Liverpool, Glasgow, Hull, and Southampton.

APPLES.

The following are summaries of the outturn of the principal varieties of apples exported this season, viz.:—

Jonathans.

The first apples to leave Melbourne were shipped on the s.s. *Anchises*. This steamer arrived at Liverpool on the 11th April after a journey of 48 days. All varieties were immature, and Jonathans, particularly, were very disappointing. There were a few lines of well-coloured fruit in good condition, but far too many poorly-coloured packs below grade, which were immature, and arrived in either a wilted, or a stale and shrivelled condition. There was also a fair amount of bitter pit, ranging from a few in some boxes up to 40 per cent severe pit in others.

The *Orcades* and *Tuscan Star* shipments, which left Melbourne later than the *Anchises*, and arrived in London five days and one day earlier respectively, showed a better outturn. Some immaturity wilt, and bitter pit were seen, but not to a prominent extent. The *Maloja* consignment followed on the 14th April, and this was most unsatisfactory, as only ten brands out of 30 examined opened up in a good or even satisfactory condition. The balance included many defects, which were described as wilted; stale and shrivelled; part good condition, part green and pitted; yellow and forward, some with water-core breakdown; and lot collapsed penicillium rot, estimated in some instances up to 4 lb. of fruit per box.

The next five steamers, including the *Port Jackson*, which arrived at London on the 27th April, were fairly good. The majority of the brands examined opened up in sound condition, but there were still many brands all immature, poorly coloured, wilted, and even shrivelled; others again, included part good, and part faulty with poor colour, far below regulation limits. Bitter pit showed in odd lines ranging from a trace, up to a lot with severe pit. Waste from fungal rots also showed up regularly, from odd apples in some boxes, to a more serious extent in others.

The *Somerset* arrived in London on the same day as the *Port Jackson*, but was 61 days on the journey from Melbourne, as against 46 days by the latter ship. The outturn of the *Somerset* Jonathans was also unsatisfactory, only thirteen brands out of 30 inspected being classified as good. The *Dunedin Star* followed with ten out of twenty good, the *Strathallan*, the last ship to arrive in April, was better, with 37 good out of 53. Arrivals of Jonathans ended with the *Automedon* shipment to Liverpool on the 10th June. Throughout this period Jonathans were most variable, and one can quote the outturn by the *Hurunui*, which arrived in London on the 19th May, as fairly typical of all.

37 brands examined, nineteen good condition and quality;
4 part good, part stale, and wilted;
2 very forward, some *Jon* spot;
3 all stale and wilted;
4 from a few up to a fair number of waste from penicillium rots.

Defects in Quality.—Weak colour generally, part below grade. Excessive severe russet.

It has been recorded many times before, but it is important to note again that, with few exceptions, the wilted or stale and shrivelled fruit was usually associated with weak or poor coloured apples.

Grading and Packing.—Generally speaking, these functions were well carried out, but, in practically every shipment, there were instances of faulty grading and packing. Grading includes such faults as the inclusion of up to 50 per cent. of 2-in. apples in a 2⅛-in. pack, 50 per cent. under size in 2¼-in. pack, 50 per cent. under size in 2½-in., and so on. As pointed out above, there were far too many instances of faulty grading for colour. Slack packs were fairly numerous, due to the use of incorrect counts, and to shrinkage resulting from the packing of immature fruit.

I cannot close my comments on this variety without reference to the splendid packs consistently put up by some growers, who, even in a most difficult season, were able to produce and pack fruit of good quality. Many other packs could easily have been included under this category, if a little more care had been exercised

Discharging Victorian fruit at the Southampton docks.

in stricter grading for colour, or the exclusion of those few apples with codling, excess tree blemishes, &c., which spoiled an otherwise good pack.

Granny Smith.

The Granny Smith variety arrived in the first shipment per *Orcades* on the 6th April, and continued on practically each steamer throughout the season. The last small consignment came forward on the *Nestor* to Liverpool on the 18th July.

From the viewpoint of condition, this variety was very disappointing. Early consignments were immature, and showed a heavy incidence of bitter pit, ranging from a few slightly affected in 2¼-in., up to 100 per cent. infection in the larger 2¾–3-in. fruit. Some brands were free of this trouble, but right up to the middle of May, sound fruit was more the exception than otherwise. A larger percentage of sound fruit—free of pit—arrived after this time, but odd lines continued to be noted for immaturity, and severe bitter pit, which was invariably associated with this condition, and which was more severe in the larger sized fruit.

The only other defects of any note in the condition were the wilting of some of the very immature lines, and severe bruising in some packs of 2¾–3-in. fruit; also odd apples affected by penicillium rots following case injury or codling stings.

Quality generally was satisfactory to good. The inclusion of a few misshapen apples, or those with severe russet, hail, codling, or codling stings, sun scald, frequently spoiled an otherwise good pack.

Grading and Packing.—On the whole grading and packing of this variety was satisfactory. There were, however, quite a number of instances of faulty grading. The inclusion of from 20 to 70 per cent. of apples under size in 2¼-in. pack, of many 2½-in. in a 2¾-in. pack, and vice versa, were some of many similar instances which occurred throughout the season. The severe bruising which occurs in the larger 2¾-in. and 3-in. fruit in this variety, as well as in other varieties, continued to show up prominently this year. Some effort should be made to overcome this defect. The use of larger papers and double wrapping would certainly help to prevent bruising.

In view of the fact that prices for this variety were always good, even throughout the period when so much immature and pit affected

fruit was arriving from Victoria, it will be difficult for many to reconcile the position. I cannot explain why buyers generally continue to pay high prices for defective apples, but I know of many instances where lots have been returned by buyers, and subsequently resold at shillings per case less than the original price. The immature fruit fails to ripen satisfactorily, the apples are without flavour, and have poor texture. My firm conviction is that the time will come when buyers will not respond to the purchase of this faulty fruit for dessert purposes, and will classify it in the culinary class. The position is serious and should not be allowed to continue. Well-matured and good quality Granny Smith apples are appreciated in these markets as a dessert apple, and must be kept in this class. The shipment of immature fruit must be prohibited, if this variety is to hold its present high position in the United Kingdom markets.

Dunns.

I have always considered the Dunn variety one of the dependable ones grown and exported from Victoria. April arrivals, this season, although there was no great quantity, were generally satisfactory. There were instances of immature fruit, wilted, and showing bitter pit, up to 50 per cent. in some brands. Only small lines continued with May arrivals, and by the end of the month this variety had finished. Condition during this time was mostly satisfactory, exceptions noted included a little bitter pit, and some yellow and shrivelled fruit.

Quality.—On the whole the quality of this variety was up to grade, but, with few exceptions, not outstanding. Some packs included apples with codling, excess sun scald, and one pack came under notice with many split at stem end.

London Pippins.

April arrivals of London Pippins included several packs showing up to 80 per cent. with severe bitter pit, and some, in variable condition, included green and yellow fruit in the same box, with mouldy core and codling in evidence. Arrivals finished by the end of May, and, on the whole, were better during this month, although instances of packs showing yellow fruit with mouldy core and many collapsed came under notice.

Some excellent packs of clean, sound, high-grade fruit came forward from time to time.

Cleopatras.

Early arrivals of Cleopatras were somewhat immature. From a trace up to 60 per cent. severe pit was recorded, while some packs had wilted. Other defects in condition included green and yellow fruit in the same case.

Quality, generally, was satisfactory.

King David.

The King David variety was variable. There were many, well coloured, good quality packs, which opened up in good condition. Others included weak to poor colour in a wilted condition, and odd lines stale and shrivelled with the pack very slack due to shrinkage of the fruit.

Delicious.

With the exception that some packs included odd waste from penicillium rots, the condition of the Delicious variety was consistently good. The quality, however, could not be classified as good on the score of colour. Victorian Delicious have never been noted for high colour characteristics, and this season's consignments were no exception. Generally, it was weak to poor, only a few lines being considered satisfactory for grade.

Rome Beauty.

The condition of the Rome Beauty variety, on the whole, was very good. An odd line showed bitter pit, but to a slight extent only.

Quality was fairly satisfactory for grade, but colour requirements, throughout the season, were weak to very poor; in fact, many packs included a fair proportion of fruit with no colour at all.

Other defects noticed, included odd packs with some severe sun scald, dry stem ring, codling or hail blemish.

Statesman.

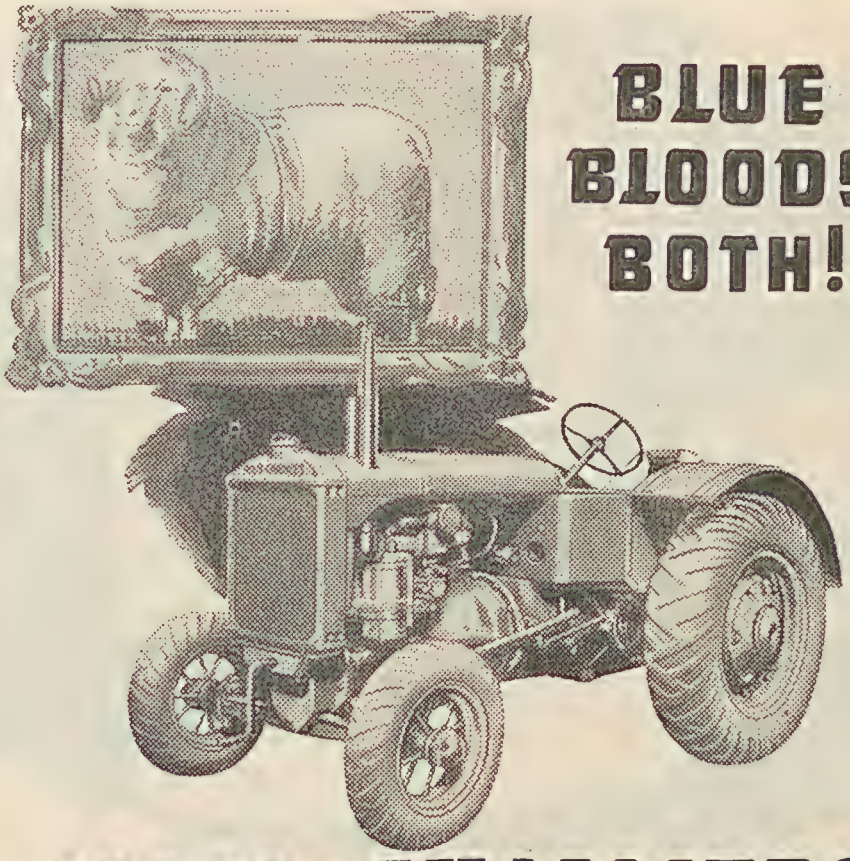
With the exception of an odd line too forward in condition, the fruit being yellow and wilted, the outturn of the Statesman variety was quite good.

Quality also was fairly good to good. Many packs included apples with colour up to the requirements for this variety, but others again showed very weak to poor colour, with a fair proportion quite green.

Alfriston.

There were only a few consignments of small quantities of Alfristons, which included several packs of sound, clean, good quality fruit.

(*Continued on page 580*



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The Argentine Ant

(*Iridomyrmex humilis Mayr.*)

By R. T. M. Pescott, M.Agr.Sc., F.R.E.S. Entomologist

THE Argentine Ant (*Iridomyrmex humilis Mayr.*), without doubt the most serious pest in the ant world, has become established in several areas around Melbourne. The first specimens of the ant were received and identified by Mr. John Clark of the National Museum, Melbourne. Its method of entry and establishment in this State can only be conjectured; the most likely method of entry being in packing material from one of the countries enumerated below.

Distribution.—The Argentine ant has now been recorded from the following countries:—Belgium, Canary Islands, France, Germany, Italy, Madeira, Portugal, Sicily, South Africa, South America, Spain, and portion of the United States of America.

How to Recognize the Argentine Ant.—The Argentine ant is somewhat similar to, and may be confused with, some species of native ants. This ant (Fig. 1) can be distinguished from other similar ants by the following characteristics:—The worker ant is about one-eighth to one-tenth of an inch long and of an almost uniformly honey-brown colour. It is slender in form and moves rather quickly. The worker ant possesses a single joint (or petiole) between the thorax and the abdomen. When several of these workers are crushed between the fingers, no noticeable odour is given off. This characterizes it from native ants of the same genus, which give off usually a somewhat sweetish, pungent odour.

The Argentine ant—Worker.
[Magnified 16·5 times.

The Argentine ant—Queen.
[Magnified 16·5 times.

In addition to these points, where it is properly established, no other ants will be found in the same area, they having been driven out by the voracious Agentine ants.

Habits and Economic Importance.—The Argentine ant is chiefly notorious as a house inhabiting species, although it may cause

serious trouble outside, as will be shown later. It is found indoors mainly in the late spring, summer, and early autumn months, although at other times individuals may be found in the house. During the winter months, it is chiefly found in hiding in the soil, in cracks and crevices, in the foundations of houses, in trunks of trees, &c.

While cosmopolitan in its feeding habits, the Argentine ant prefers sweet foods, such as sugar, syrups, honey, jams, sweets, &c. It is also a nuisance inside the house, in that in its foraging for food the worker ant enters cupboards, safes, clothing, bedding, and has even been noticed overseas entering refrigerators. The mere presence of ants searching for food in the kitchen, pantry, &c., causes most persons to attempt drastic means of controlling them. They are potential pests to young children, climbing into cots and prams, and entering the children's mouths, noses, and ears in their foraging. As far as is known, they do not transmit human diseases.

Out of doors, they become a nuisance by their very numbers as well as by the damage they do. In some areas, they form numerous trails up and down trunks of trees, along streets, fences, the foundations of houses, and on the ground. In heavily infested areas, it is not uncommon to see trails of 5 or 6 inches wide on the trunks of trees.

In America, they are also reported as caring for and protecting such destructive insects as mealy bugs and aphids, enabling these insects to become so abundant as to cause serious damage to plants, such as citrus trees. These ants may also affect plants directly. Gardeners may find lettuce and other small seeds removed from the seed bed by the workers. They may enter the calyx end of ripe figs and split apricots and peaches and gnaw into the flesh; they may cut through the buds of carnations and orange blossoms in order to reach the nectar.

Poultry raisers in areas in America where these ants are abundant, report that the ants drive hens from the nests by their crawling over them, and may kill newly hatched chickens. Bee-keepers also have a serious time, the ants invading the hives for honey, finally destroying the colony.

Method of Spread.—The unusually rapid spread of the Argentine ant in other parts of the world has been due to its ability to produce enormous numbers, its habit of exterminating competitive species as it spreads, its lack of natural enemies, its omnivorous feeding habits, and especially its ability to thrive in human habitations as well as in areas where no settlement exists.

Its distribution takes place by both artificial and natural means. Artificial spread has been by far the more important, the ants being carried in shipments of lumber, plants, dry foods, groceries, &c.

The natural spread of this ant is usually slow, because dispersion is dependent on crawling rather than on flying. Normally they only move forward a hundred yards or so per year.

Control.

The Argentine ant can be controlled only through continuous and relentless efforts on the part of the community. Control must be directed against the queens in the nests, for relief can only be expected when the queens are greatly reduced in numbers.

In the United States of America, where control methods have been in operation for many years, greatest reliance is placed on the use of a poison syrup bait, known as the "standard Government-formula Argentine ant poison." This is prepared as follows:—

Sugar (granulated) ..	1 pound.
Tartaric acid (crystallized) ..	10.3 grains.
Benzoate of soda	14.6 grains.
Water	$\frac{5}{6}$ pint
Sodium arsenite (chemically pure)	26 grains.
Honey	$2\frac{1}{3}$ ounces.

Specific directions for preparing this syrup are as follows:—Warm $\frac{5}{6}$ of a pint of water in a clean vessel over a low fire. When it is tepid, add the tartaric acid, the benzoate of soda, and then the sugar slowly, and stir constantly to prevent burning. Measure the depth of the liquid in the vessel with a stick. Slowly bring the mixture to the boil and allow it to simmer for 30 to 40 minutes. Remove from the stove and add water to the original depth on the measuring stick to make up for evaporation. Stir in the $2\frac{1}{3}$ ounces of honey before the mixture cools; then add the 26 grains of sodium arsenite which has been dissolved in 1.8 fluid ounces of hot water and partially cooled before pouring into the syrup.

The poison baits should be put out in suitable containers measuring about $2\frac{1}{2}$ inches in diameter and 4 inches in depth (see Fig. 2) containing a small amount of cotton wool or

(*Continued on page 586.*

Pasture Improvement in the Boort District

By A. Morgan, B.Agr.Sc., Irrigation Field Officer

THE rye-grass and subterranean clover section of the pasture competition, conducted by the Boort Agricultural and Pastoral Society, this year provided a surprise for exhibitors in that it has been won by Mr. J. D. Fyfe's exhibit of *perennial* rye-grass and subterranean clover.

The history of the paddock is so interesting to the agrostologist, and so illustrative of the success which follows the application of correct methods of pasture improvement, that it can be taken as an object lesson, not only for the Boort district, but for all the irrigation districts where subterranean clover is highly valued because of its usefulness under conditions of infrequent water supply. Even in districts where water is available at a frequency suitable for the development of lucerne and permanent pastures, there are often two factors which singly or in combination make a strong recommendation for the use of subterranean clover as a pasture plant for a period. These are the factors of area and fertility.

Considering the factor of area: Every irrigator will admit, even where he does not put his belief into practice, that the grading and banking of land into relatively short and narrow bays on the "border" system gives a control and economy of water which is highly desirable. It is desirable from the viewpoint of reduction of costs of production of lambs, wool, meat, milk and butter, and consequently must interest every landholder in its relation to profits from the farm, and it is equally desirable that the efficiency of the water storages of the State should be brought to a maximum through the best use of water when it is delivered on the farms.

Where properties are large, and the water-right is insufficient to provide adequate insurance for large areas of summer-watered permanent crops, the combination of graded land and a winter-annual pasture plant offers the best solution of the problem. From all the aspects of productivity, water-cost, palatability to stock, high nutritive value, and response to top dressing, the best winter annual to employ is subterranean clover. We have had the evidence of this before us for many years, but there are still many properties where no attempt has yet been made to capitalize it.

Considering the factor of fertility: The experience of the irrigator on his own block demonstrates definitely that certain soil types in every district may be poor yielders when sown with lucerne and permanent pastures unless the originally low fertility is augmented by a programme of top dressing. He may have a sufficient area of more fertile soils on which lucerne and permanent perennial pasture can be grown, but is loath to persevere with the summer-watered crops on the poorer soils. Poor soils can not be neglected, however, but must be built up to as high a carrying capacity as possible.

Available nitrogen appears to be the foundation-stone of high production under irrigation, and the problem is to secure it as cheaply as possible. The application of nitrogenous manures such as sulphate of ammonia, nitrate of soda, blood and bone, &c., has been investigated for irrigation conditions, but provides only temporary increases in the vigour of pasture plants, while the cost is out of proportion to the results achieved. Indirectly and cheaply, however, we have been able to solve the problem by the joint use of superphosphate, legumes, and irrigation water. Primarily we used superphosphate to make up the general deficiency of available phosphate exhibited by Victorian soils, but we have found it equally important as a source of nitrogen through its action on clovers.

The visible evidences of accumulation of nitrogen through the medium of the clovers are increased growth with a more healthy colour, and the formation of a layer of organic matter on the surface of old pastures which have been spared from periodical cultivation. The mulch formed in this way has other uses of special significance to the irrigator, particularly in the north where cracking is often rapid and extensive with the commencement of summer unless a strong vegetation cover is maintained. Manuring and watering alone

do not suffice to maintain the cover in the shelter of which the protective coat of humus is formed, but when these are attended by well-regulated grazing its formation is assured.

The Winning Pasture.

In the case of Mr. J. D. Fyfe's winning pasture the process has gone a step further, since the annuals—Wimmera rye-grass and other volunteer annuals such as barley grass—have been displaced by perennial and false perennial rye-grasses which are showing vigourous growth under a watering schedule which is designed for annuals.

The field is 6 acres, graded and banked to form three bays of 1 chain width. The bays are thus 20 chains in length, which is far in excess of the optimum length of run for the fall the ground possesses, and better use of water would be derived by putting in another channel at the 10-chain mark. Apart from this defect, for which comparable points were lost, the pasture at the time of judging (12th October) could not be too highly commended. The rye-grass was particularly leafy and fine, with a very attractive colour, and examination of bales of hay cut from the paddock last season showed that these characteristics are usual with it. A good balance of grass to clover was present, and the growth was bright and succulent. Weeds and weedy grasses, except for a very few shore thistles (slender thistles, *Carduus pycnocephalus*), were inconspicuous. Its productivity was shown last season when it cut 40 bales (each 90 lb.) of meadow hay per acre, all of which was of excellent quality.

Manuring has had a great deal to do with its progress, as during the last four years the top dressing has been at the rate of 4 cwt. per acre. Altogether, the paddock is about fifteen years old, and the rye-grass present effectively disposes of the argument that it is more necessary to cultivate subterranean clover paddocks, to keep them grassy, than it is to manure them properly. In the 1939 *Guide Book to the State Research Farm, Werribee*, page 26, the following information is given:—"Autumn renovation with pasture harrows of the Wimmera rye-grass and subterranean clover pasture prior to germination has been tested during three seasons. The results have been very satisfactory, a more uniform germination of both species and a better growth of the grass constituent being obtained. The harrowing has been responsible for the thinning out of inferior annual grasses, particularly barley grass, and there is a marked contrast between the harrowed and the unharrowed sections."

There are factors to be taken into consideration in respect of this statement, however, which do not apply with equal force to the subterranean clover paddocks in the Boort district. In the first place the Werribee experiment has been carried out with unirrigated land with an average annual rainfall of about 20 inches, and the subterranean clover is established in wallaby grass (root grass, *Danthonia* spp.) by surface sowing on ungraded land. Secondly, the amount of topdressing which can be profitably done under these conditions is limited, which is not the case with the irrigated subterranean clover at Boort. Under irrigation, a more permanent stage of balance between the grass and the clover will be arrived at by discarding harrowing in favour of plenty of superphosphate, careful watering, and regulated grazing. The main use of cultivation should be to rectify any

THE AWARDS.—BOORT PASTURE COMPETITION.

Exhibitor.	Lay-out and Condition of Channels.	Mixture.	Condition.	Uniformity.	Freedom from Weeds.	Total.
Possible Points	20	20	20	20	20	100
J. D. Fyfe	17	19½	19½	19½	19½	95
V. H. Lanyon	15	18½	19	19½	19½	91½
B. Weaver	19	17	18½	18½	18½	91½
A. N. Lanyon	15	18½	19	19	19½	91
L. Weaver (No. 2)	19	18	14	17	18	86
L. Weaver (No. 1)	17½	17	15	19	17	85½
H. L. Smith	5	12	14	16	15	62

faults in grading which become apparent after a few years of watering. For convenience in stocking subterranean clover during the winter, a consolidated soil is desirable, and this will not be attained by frequent use of cultivating implements.

Other Exhibits.

The remainder of the exhibits can be divided into two classes, (i) paddocks imperfectly adapted for watering, but carrying fine swards of subterranean clover with a strong admixture of weedy annual grasses; and (ii) paddocks excellently planned for irrigation, but suffering from lack of water. The early "break" last February, and the continuance of unsettled weather throughout autumn and winter, were responsible for the bulk of the first class, and the prevalence of an abundance of "natural" feed had a great deal to do with the second. Most of the first class had been graded, but time had not been available to erect banks. Only one exhibitor claimed to be satisfied without banks.

Considering the present position of this district in regard to water supply, points must be marked down heavily where all factors of layout are not attended to. A survey of the points awarded will show that it was on layout that Messrs. V. H. Lanyon and A. N. Lanyon's exhibits dropped advantages which they had gained in the remaining sections of the schedule, and the second prize is shared by Messrs. V. H. Lanyon and B. Weaver. Views may differ in regard to the analysis of the twenty points possible for layout, but in the judge's opinion these points would be most equitably allotted on the basis of a maximum of three for banks on ungraded land where crabholes are prominent, two for condition of the supply channel, ten for grading unaccompanied by banking, three for width and length of run, and two for provision of drainage facilities which will meet all ordinary emergencies. In some circumstances it may be necessary to revise this apportionment, but for most situations suitable for the irrigation of subterranean clover it provides a good working scale.

The figures quoted by exhibitors for stock-carrying on subterranean clover pastures were high, and averaged five sheep to the acre or its equivalent. In this report it is not intended to give full details of the stocking of the winning pastures, as it is felt that a more useful purpose will be served by commenting on some aspects of management which have a big influence on carrying capacity.

Manuring has already been touched on and from observations made outside the scope of the competition it is felt that the subject of watering of subterranean clover needs more careful study by a large number of growers. We use subterranean clover in preference to "natural" herbage because it is later-maturing. By irrigation it can be carried on a month longer than the herbage of unimproved land. To build up a good sward which will exclude barley grass, &c., a good seeding is essential, especially for new paddocks.

The development of long runners with vigorous laterals is important in respect of the amount of good seed produced by each plant, and it is decidedly disadvantageous to subject subterranean clover to haphazard waterings spaced so far apart that wilting or shrivelling of the leaves is permitted. Continuous growth is the ideal, and for that the need for water has to be anticipated, not remedied.

Rainfall must not be relied upon to the extent of allowing recurrent shortages of soil moisture. This same tendency, which has been aptly described by Commissioner Hanslow of the State Rivers and Water Supply Commission as "sky irrigation", has been responsible for many failures with both annual and perennial pasture ventures in the northern irrigation districts. In some cases it represents a short-sighted immediate saving which is suggested by considerations of stock prices, &c., but it fosters an opportunist outlook which reacts unfavorably on the rate of progress of the property.

Another feature of watering which in general is not adequately appreciated is the value of the early start, to give a good bulk of feed before the "dead period" of winter (July, August). Those who wait for rainfall will, on the average, fare worse than those who start the subterranean by irrigation in early March. Some idea of the value of the practice is given by the carrying of 13¼ sheep to the acre during May on a prize-winning subterranean clover pasture in an adjoining district. It is also interesting to note that the grazing system followed was to feed off for three to five days at monthly intervals.

Pig Carcasses at the Melbourne Royal Show

By L. A. Downey, Pig Expert

IN the Bacon and Pork Pig Section of the 1939 Show of the Royal Agricultural Society of Victoria, there were three classes for baconers and two classes for porkers which were required to be judged after slaughter on the British system of pig carcass appraisal, the points being as follows:—

	Possible points.
(a) By Inspection—	
Hams—well filled and fine boned	8
Shoulders—light	7
Streak—thick and full of lean meat	12
(b) By Measurement—	
"Eye" of loin muscle—thick	28
Back fat thickness—correct proportion	20
Body length—in proportion to weight	20
Leg length—short	5
Total	100

In this system of carcass judging practically nothing is left to the personal opinion of the judge. The inspection points are valued in comparison with photographic standards, and the measurements are converted to marks by the use of standard tables in accordance with the carcass weights.

Seventeen bacon pigs and sixteen pork pigs were submitted to the carcass judging which was carried out at the Western and Murray Bacon Factory.

A study of the points scored by each pig in the three bacon classes shows the following averages:—

	Per cent.
Hams	57
Shoulders	54
Streak	66
Loin Muscle	79
Back fat	77
Body Length	40
Leg length	74

Messrs. Trenery and Soderland's Large White sow whose carcass scored 72½ per cent. and was awarded first prize in the class for best baconer of any pure breed or first cross.

The striking feature of these scores is the low average of 40 per cent. for body length, and to fully realize the importance of this it must be noted that a possible of 20 points is allowed for body length out of the total of 100, as compared with 8 for hams and 7 for shoulders.

Pig breeders realize the importance of body length in breeding pigs, and the trade's view of body length is indicated in the 20 marks allowed in this system of carcass appraisal.

The average difference between the actual body length and the standard body length for the seventeen baconers was 2⅜ inches, which is very considerable.

The marks awarded for body length are affected by the amount of fat on the carcass, a very fat pig having extra weight without compensating length of body, but with these seventeen pigs the average condition or amount of back fat was fairly good, their average score being 77 per cent., and while some pigs were too fat, some were too thin.

The question arises as to where else the weight is situated if it is not in the length of the body from the aitch bone to the first rib, and is not accounted for as excess back fat. It may be accounted for, in part, by excessive depth of body—a feature not desired by the trade—as a big proportion of lean back meat and not a very long rasher of bacon is required.

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Pig breeders and judges frequently strive to select pigs with great depth of body, contending that these are "good doers," but pig recording in other countries has demonstrated that increased body length with decreased depth does not mean decreased production either in breeding sows or in growing pigs.

While a full and level underline and thick flanks are desirable in the live pig, and in the carcass, there does not appear to be any justification for selecting pigs with excessive depth of body.

The results of these seventeen pigs confirm previous appraisements of Australian pigs in indicating the marked need for increased body length.

As it is probable that there exists a correlation between relative body length and the number of vertebrae in pigs, the ribs of each pig in these classes were counted and found to vary from 14 to 16 pairs, the average being 14.8 pairs.

The two classes for porkers included sixteen pigs whose average scores were as follow:—

	Per cent.
Hams	62
Shoulders	63
Streak	59
Loin muscle	63
Back fat	73
Body length ..	43
Leg length	81

As with the baconers their body length was very deficient. The ribs of the porkers varied from 14 to 16 pairs with the average 14.9 pairs.

Although the desirable baconer or porker carcass should have great length in proportion to weight, the other features enumerated in the list of points are very desirable, but from the available evidence it appears pig breeders should put greater emphasis on body length.

The impracticability of correctly assessing body length in live pigs is a difficulty in the way of rapid improvement, and it is only in carcass competitions and on other rare occasions that breeders get an accurate appraisal of their pig carcasses, but probably the best indication of body length that breeders have at present is the number and placement of pig teats.

Most pigs have twelve teats and some have less; many pigs have fourteen teats and some have more. All pigs with fourteen or more teats are not long bodied, but most of them are, and it is therefore considered that in the selection of breeding stock both boars and sows with fourteen well-spaced teats should be looked upon with favour, but it must be realized that the spacing is as important as the number of the teats.

Fertilizers Act

Prosecution for Offence

On 27th October, 1939, at the Sunshine Court of Petty Sessions before Mr. Pyvis, P.M., and bench of honorary justices, the Western and Murray Co-operative Bacon and Meat Packing Company Limited were charged under section 16 of the *Fertilizers Act* 1928. Evidence was given that a sample of W. & M. in circle blood and bone fertilizer withdrawn from stock on the premises of the defendants on 18th July, 1939, was found on analysis to be deficient in nitrogen and phosphoric acid to an extent exceeding the limits allowed by the Act.

The defendants pleaded guilty, and gave evidence that owing to the abnormal season difficulty was experienced in drying the fertilizer. The Department stated that there was no suggestion of adulteration. Defendants were convicted and fined £5, with £4 6s. 9d. costs.

Poultry Pests

By R. T. M. Pescott, M.Agr.Sc., F.R.E.S., Entomologist, and H. F. Clinton, F.R.M.S., Poultry Expert

THERE are many insects and closely related forms which attack poultry in Victoria. Most of these are to be found as external parasites on the domestic fowl, while several others are also present on the turkey, duck or goose. As the domestic fowl constitutes the greater portion of the poultry industry of the State, it is proposed to discuss only those pests with which it is concerned. The main ones present in Victoria are :—

The red mite.—*Dermanyssus gallinae* L.

Lice—

The common hen louse—*Menopon gallinae* L.

The wing louse—*Lipeurus caponis* L.

The head louse—*Lipeurus heterographus* Nitzsch.

The body louse—*Eomenacanthus stramineus* Nitzsch.

The fluff lice—*Goniocotes gigas* Tasch., *Goniocotes gallinae* Retz., and *Goniodes dissimilis* Nitzsch.

The fowl tick—*Argas persicus* Oken.

The scaly-leg mite—*Cnemidocoptes mutans* Robin & Lanq.

The depluming mite—*Cnemidocoptes gallinae* Railliet.

In addition to the above, a short account is given of the stickfast flea—*Echidnophaga gallinacea* Westw. which, though not yet present in Victoria, is present in some of the other Australian States, and should be watched for carefully.

The Red Mite.

(*Dermanyssus gallinae* L.)

The red mite is the most serious external parasite of poultry in Victoria.

Fig. 1.—The red mite of poultry.

Nature of Attack.

The red mite attacks adult poultry as severely as young chickens. The mites normally feed upon the birds at night, leaving them during the day to hide in the cracks and crevices of the perches, walls or surrounding woodwork of the pens, or nest boxes. They have a habit of congregating in groups, and it is not uncommon to find swarms of them under the roosts. The results of the attacks by red mite may be fourfold :—

(*a*) They may cause a great reduction in egg production.

(*b*) By their constant feeding and irritation of the skin of the bird, they may cause sitting hens to leave their nests.

(*c*) In severe cases, they may cause great loss of flesh, unthriftiness and reduction of vitality

(*d*) They may transmit poultry diseases from infected birds to healthy ones.

Hosts.

The hosts of the red mite are the domestic fowl, duck, goose, and turkey.

Description and Life History.

The red mite is a small, pear-shaped, blood-sucking mite (Fig. 1.) measuring about one thirtieth of an inch long and one forty-fifth of an inch wide. The adult female lays her small, shiny white, oval eggs in the hiding places among cast skins, dust, and other debris. In from two to six days they hatch into tiny, active, six-legged mites. These feed for a short time, and cast their skins, emerging this time with eight legs. Finally, after several moults, they reach maturity. These mites are capable of living some time without food.

Control.

The control measures for this pest are directed chiefly at the hiding places. These should be either sprayed or painted with one of the recognized insecticides such as crude oil, a mixture of crude oil and kerosene, nicotine sulphate or nicotine preparations, tar oil or sheep dip. If a spray is used, it should be forced thoroughly into all cracks and crevices.

Fig. 2.—Common louse of the fowl.

The chief method of transmitting red mite from one poultry farm to another is per medium of coops and crates. It is therefore essential that these be thoroughly examined on arrival, and, for preference, dipped, or well sprayed with one of the previously mentioned materials.

Lice.

The lice found on the domestic fowl in Victoria are all biting forms, and there are at least six species concerned. These various species are given common names, according to the part of the bird attacked, e.g., there are the common hen lice (Fig. 2.); wing lice (Fig. 3.); body lice (Fig. 4.); head lice (Fig. 5); and fluff lice (Figs. 6, 7, and 8).

Nature of Attack.

Lice attack both young and adult birds. The injuries caused are largely due to the irritation

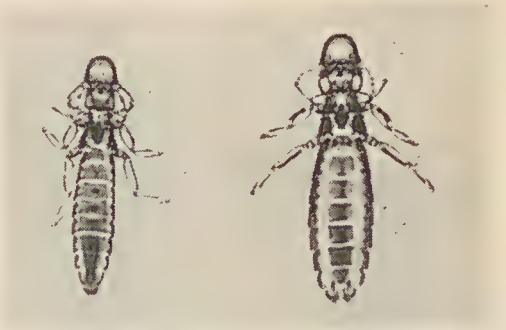

Fig. 3.—The wing louse. Left, male; Right, female.

and itching caused by the insects creeping over and gnawing at the skin. Excessive infestation produces a marked restlessness, which is a serious hindrance to normal growth and development. In severe cases, there is a greatly reduced egg production and loss of weight, while brooding hens may be so annoyed as to interrupt incubation. With young chickens, the irritation produced may sometimes be fatal. Abundance of the lice usually accompanies general uncleanliness and overcrowding.

Hosts.

The domestic fowl is the most common host for lice but they may be found on other poultry.

Description and Life History.

Lice are external parasites, and are generally limited to a specific host, with the entire life cycle normally spent on that one host. The female lice lay their eggs either on the feathers

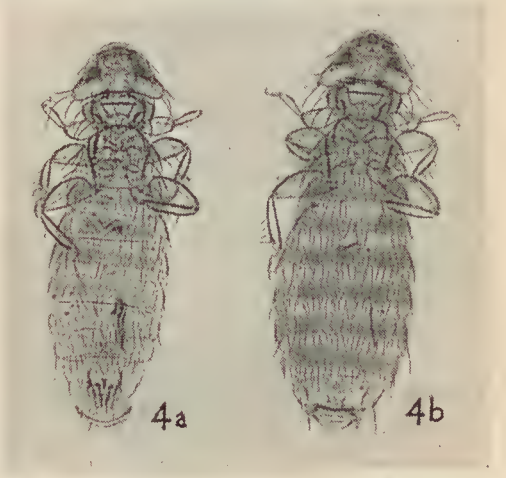

Fig. 4.—The body louse, 4a, male; 4b, female.

or on the base of the quills, and are attached there by means of a sticky secretion. The eggs or "nits" are laid singly over a period of two or three weeks, depending on the life of the adult

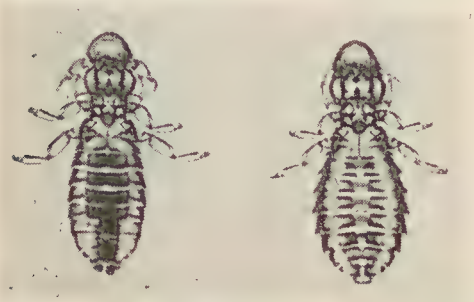

Fig. 5.—The head louse. Left, male; Right, female.

insect. The incubation period varies somewhat with different species, but, in general, is usually from five to eight days. The young lice emerging from the eggs are similar to the adult except in size, and they moult several times before reaching maturity in three to four weeks.

Control.

The most satisfactory agent for the destruction of the biting lice on poultry is commercial sodium fluoride. This may be applied by the "pinch" method, when the bird is held on a table and the sodium fluoride applied next to the skin under the feathers, a pinch under the head, one on the neck, two on the back, one on the breast, one below the vent and on the tail, one on each thigh, and one on the underside of each wing; or by the dusting method—three parts of flour to one of sodium fluoride, the powder being dusted on by means of a shaker. In each case the feathers should be ruffled to allow the powder to reach the skin.

Fig. 6.—A fluff louse (G. gigas) (female).

For the treatment of large numbers of birds, dipping is suggested—1 oz. of commercial sodium fluoride to each gallon of water. The birds should be held by the wings and plunged into the solution, ruffling the feathers with the hands. The head should be ducked under twice. Dipping should be done only on warm days, and completed in sufficient time to allow the birds to dry before sunset. For young chickens, the "pinch" method is preferable, small amounts only of sodium fluoride being used.

Fig. 7. A fluff louse (G. gallinae). Left, male; Right, female.

Generally dipping is quicker and more economical, and 1 lb. of sodium fluoride is sufficient to treat 200 birds. It has the added advantage that the irritating effect on the respiratory tract of the operator (where dusting is practised) is avoided. When dusting, a protective mask over the nostrils and mouth should be worn by the operator. Other materials sometimes used are sulphur and insect powders containing pyrethrum.

A practice now in general use is the application of nicotine sulphate undiluted and applied to the perches before the birds roost, at the rate of $\frac{1}{2}$ oz. to 100 ft. of roost. The fumes from the spray rise through the birds during roosting, and cause the lice to drop from the feathers.

With head lice, particularly on chickens, a non-irritating oil such as castor oil, or vaseline, should be applied directly to the affected area.

Fig. 8.—Another fluff louse (G. dissimilis). Left, male; Right, female.

The Fowl Tick

(*Argas persicus* Oken.)

The fowl tick is a serious and troublesome pest in most of the warmer parts of the State, while, in the cooler parts, it does not thrive so well.

Nature of Attack.

The effects of the fowl tick on the birds are often very severe. The ticks, by their feeding, not only cause the birds great discomfort at night with consequent loss of sleep, but also, by the constant blood sucking, produce a direct injury. This is due to the amount of blood actually sucked up by the ticks, and also to poisonous substances injected into the bird while feeding. Young chickens are usually most seriously affected, and the weakness caused in many cases is often fatal.

In addition to this direct damage and loss, the fowl tick is also responsible for the transmission of a harmful organism, which is the cause of tick fever, into the blood of the bird. This disease, which is evidenced by a rise in temperature, restlessness, blackness and shrinkage of the comb, prostration and paralysis, is often fatal among fowls.

Host.

Hosts of the fowl tick include the domestic fowl, ducks, geese, turkeys, pigeons, ostriches, canaries, wild birds, and cattle.

Description and Life History.

Ticks in various stages of their growth, together with their eggs, may be found concealed in the cracks and crevices of houses and perches. The eggs, which number from 500 to 900 per female, are of a brownish colour, and about one fortieth of an inch in diameter. They are usually laid in sheltered positions. These eggs hatch out in from three to four weeks from the time they are laid. The newly-hatched ticks measure about one thirty-second of an inch long, have three pairs of legs only, are oval in shape, flattened and with thin edges, and are covered on the upper surface with small pits of various sizes. Their colour varies from brownish to grey black. They are without eyes.

These young ticks crawl on to the birds and remain attached to the skin for about five days or so. They may be seen in small clusters, blue-black in colour, with their mouth parts inserted into the skin, usually on the breast, under the wing, or on the thighs (Fig. 9.). During this period of growing, they will get enough nourishment to sustain them for a period, and they then seek hiding places in the perches and walls. Feeding occurs only at night.

The adult ticks have four pairs of legs, measure from one quarter to one third of an inch in length, and are flat, oval, and grey-black in colour (Fig. 10). In this stage, they visit the birds at night, and, in from 20 to 45 minutes, become fully engorged with blood, returning then to cracks and crevices in the house and perches.

Fig. 9.—Body of a fowl showing clusters of ticks. [After Lanrie.

Fig. 10.—Fowl ticks at various stages of growth, and eggs.

From the time of hatching, the adult stage may be reached in 30 days. It is well known, however, that the fowl tick will remain for two years or more without recourse to the fowl for food. This fact makes eradication of the pest, once it has become established, extremely difficult.

Control.

The fowl tick is a very difficult pest to deal with, as not only is it resistant to ordinary insecticides, but also its habit of hiding in deep cracks, &c., protects it to a very large extent from any spray treatment.

In those houses which are infested and are not properly constructed, or are of little value, it is better to burn them and rebuild on new ground. The ground where the old structure stood should be saturated with a strong disinfectant. As adult ticks are able to live at least two years in an empty fowlhouse, it is of little use excluding the fowls for any length of time as a control measure. Angle iron should, where practicable be used in place of wood in the construction of the fowlhouse. For economic reasons, all houses should be built so that, in case of an outbreak, they can be readily dismantled. They should be also built away from any other buildings or structures. Any wood used should be carefully selected, and should be as free from cracks as possible. In any circumstance it should be coated with tar.

The perches, too, should be coated with tar, and they should be made so that they can be easily dismantled, for it is well to remove them regularly, as there is always a possibility of ticks finding a hiding place between the perches, and the walls of the house. The perches can be made so as not to touch the fowlhouse walls by suspending them from the roof on wires, or else placing them on supports rising from the floor.

If fowl tick is present, either crude oil, tar oil, nicotine preparations, sheep dip, or kerosene emulsion, makes a satisfactory spray, and should be thoroughly forced into all cracks and crevices. Before spraying, all litter, nesting straw, and loose boards likely to protect the ticks should be removed and burned. The spraying treatment should be repeated every three or four weeks until no more ticks are seen. Special coops should be set aside so that any newly purchased fowls may be quarantined for a time (usually about ten to twelve days) as a prevention against introducing fresh infestations.

Pepper trees (*Schinus molle*), with their loose bark, have been known to harbor large numbers of the pests. Ticks will travel along an infested fence to a new poultry house, and they and their eggs may at times be conveyed from place to place by egg cases, crates, utensils, &c.

The Scaly-leg Mite.

(*Cnemidocoptes mutans* Robin & Lanq.)

The scaly-leg mite is the commonest itch mite affecting poultry in Victoria.

Nature of Attack.

The first signs of attack by the scaly-leg mite are found in the clefts between the toes, and the mites spread forward and upward until the foot and the leg become affected. The two legs are

Fig. 11.—The scaly-leg mite.

usually attacked at the same time, and show the condition to the same degree. At first there is only a slight roughening of the surface of the legs, but the continued irritation by the mites causes the formation of a spongy or powdery substance under the scales, which become raised and finally easily detached. This proliferation and exudation causes a marked irregular thickening of the legs and toes, which are covered with thick, greyish-white crusts (Fig. 12.). Very occasionally, the comb and wattles may be attacked.

Scaly leg is very readily transmitted from bird to bird.

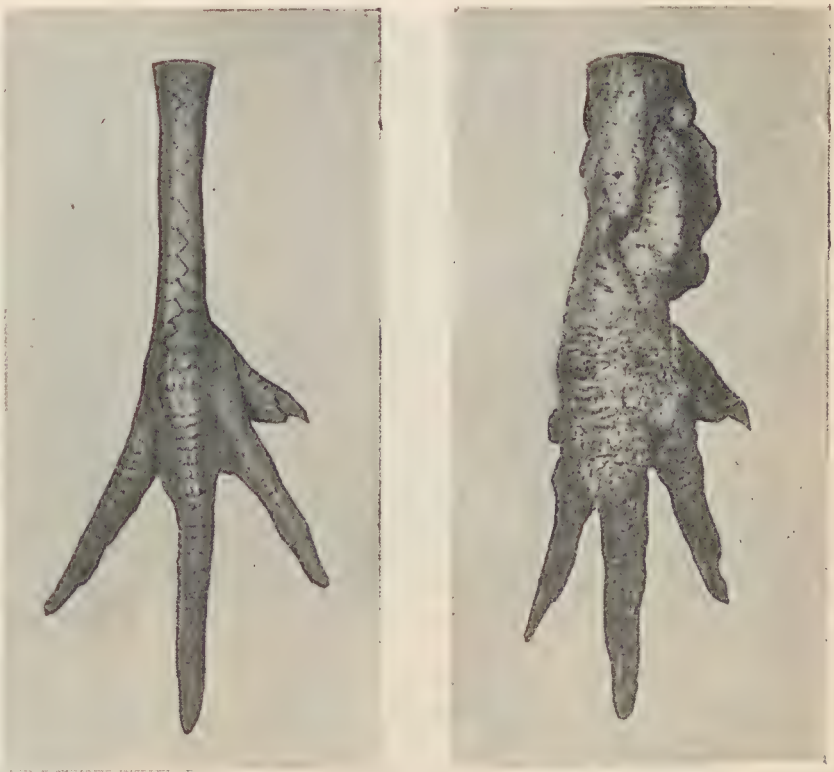

Fig. 12.—Left, healthy shank and foot of fowl. Right, shank and foot of fowl affected with scaly-leg mite.

Hosts.

Common hosts for the scaly-leg mite are domestic fowls, turkeys, pheasants, pigeons, and cage birds.

Description and Life History.

The adult mite, which measures only about one eightieth of an inch in length, is round in shape, and burrows into and lives in the skin. The female mite deposits her eggs in these positions, and, on hatching, the young mites migrate slightly to set up fresh colonies of infection on the same bird, or migrate along the perches, &c., to other birds.

Control.

The most effective treatment for scaly leg is to dip the feet and shanks of the affected bird in crude oil, and scrub thoroughly with a hard brush. Care should be taken not to get the oil on the upper parts of the legs or on the feathers. Dipping is best carried out in the morning to allow the oil to drain off before the birds go to roost. Usually one application is sufficient, although in bad cases it may be necessary to repeat the treatment in a month's time.

Washing the legs in soap and water, removing loose scales with a brush, and applying a mixture of lard 9 parts and sulphur 1 part is also an effective treatment. Disinfection of the perches by spraying with crude oil is also recommended as a preventive.

The Depluming Mite.

(*Cnemidocoptes gallinae* Railliet.)

The depluming mite lives at the base of the feathers, causing an intense itching, and producing the condition known as "depluming scabies". It infests the portion of the quill lying beneath the surface of the skin, at first on the body and progressing to the neck, thighs, and head. The irritation leads the fowls to pluck out their feathers, the quills of which will be found surrounded by scales and crusts (feather pulling). A bald patch is thus left in the skin which is but little thickened, and remains normally smooth and elastic. The condition frequently spreads rapidly.

Host.

The common host for the depluming mite is the domestic fowl.

Description and Life History.

The depluming mite is very similar in appearance to the scaly leg mite, but smaller in size. It has a similar life history.

Control.

The control of this mite is best accomplished by dipping the birds in a solution containing 2 oz. of flowers of sulphur, and $\frac{1}{2}$ oz. of soap to each gallon of water. Lice and depluming scabies may be treated with this bath to which has been added $\frac{3}{4}$ oz. of sodium fluoride. The application of sulphur ointment to the affected parts is also recommended.

The Stickfast Flea.

(*Echidnophaga gallinacea* Westw.)

As previously mentioned, the stickfast flea, while present in some of the other Australian States, has not, up to the present, been recorded in Victoria. Poultry farmers are advised to watch carefully for the insect, as it is a serious poultry pest.

Nature of Attack.

On birds the areas that usually are attacked are those devoid of feathers. The insects may be mistaken, at first glance, on poultry for small

Fig. 13.—The stickfast flea.

blood specks on comb and wattles, but closer examination will reveal them as fleas attached to the skin (Fig. 14.). By their constant feeding on the blood of the bird, they may cause death in severe cases, in others diminution in egg production, and general loss of condition.

Infection may be spread from farm to farm by very many means, such as by the movement of old crates, fittings from fowl runs, fowl houses, nesting boxes, poultry and pigeon manure (which harbor the eggs), &c.

Hosts.

In addition to poultry, pigeons, dogs and cats, particularly in sandy areas, may be frequently attacked, while less commonly, this flea is found on native birds, horses, rats, mice, and rabbits.

Fig. 14.—Stickfast fleas attached to a fowl.

Description and Life History.

The adult flea is dark brown to almost black in colour, rather shiny, and measures about one twenty-fifth of an inch in length (Fig. 14.). This flea remains permanently on the portion of the body attacked, not moving from one part of the bird to another as with other fleas. This habit of remaining firmly attached to one portion of the body has given rise to the name "stickfast". The length of life of the adult flea is dependent chiefly on the availability of food, i.e., blood, and climatic conditions.

The eggs, which are very minute, are dropped by the female flea while attached to the host bird. These hatch in from four to six days during the summer months to small, worm like, white maggots, measuring about an eighth of an inch long when fully grown. These larvae live under the surface of the soil, feeding on partly digested blood which has been evacuated by the adult fleas on the birds, or on the organic matter contained in fowl droppings. The length of life in this stage varies considerably, according to climatic conditions. When fully grown, the larva

(*Continued on page 579.*

Poultry Feeding

Departmental Tests Reviewed

By W. O. Pederick, Assistant Poultry Expert.

DURING the last eighteen years numerous feeding tests have been conducted at the State Research Farm, Werribee. The object of these tests has been to find the methods of feeding that will give the best results for egg production under conditions similar to those that exist on commercial poultry farms. The birds used each year are White Leghorn and Australorp pullets and when dividing them into the different pens, their age, breeding and quality are taken into consideration to ensure that, as far as possible no pen has an advantage over another.

A large laying shed, 120 feet long by 20 feet wide, divided into ten pens, with accommodation for 50 birds in each pen has been used exclusively for this work. All birds are kept confined—there is no outside run. A little over 4 square feet of floor space is provided for each bird. A careful record is kept of the amount of food consumed and the number of eggs laid by each pen each day. At the conclusion of each test the cost of food is arrived at by taking the wholesale prices of different foodstuffs as published in the press each week, and all eggs laid are valued at the highest wholesale price for eggs each week. No deductions are made for marketing charges, which makes the profit over feed cost appear rather high, but this method is considered the most satisfactory for comparative purposes as those charges would vary on different farms in different localities.

The tests commence on the 1st April each year and extend for approximately twelve months. Tests which cover only a portion of the year may be very misleading as production varies according to the time of the year. In view of the fact that these trials have covered a fairly long period and during that time nearly 7,000 birds have been tested, the results should be fairly conclusive. Many different foods and systems of feeding have been tried and much valuable information on the average production of the different breeds, palatability and suitability of foods, &c., has been tabulated.

The first experimnet in 1921–22 was to test the economic value of oats and barley as compared with wheat as a food for egg production. During that year wheat was at a very high price, reaching

9s. per bushel, while oats and barley were only 3s. to 3s. 6d. per bushel. The results showed that the birds which received only oats as a grain food averaged 170 eggs per bird, those on barley 144 eggs per bird, those on wheat 150 eggs, and those on mixed grain (wheat, oats and barley) 157 eggs per bird.

The conclusions to be drawn are that Algerian oats (not hulled) are a thoroughly satisfactory feed and should be more generally used. Barley gave a poorer egg yield, but as the cost of feed was much lower than in the "wheat fed" pen, the profit over food cost was higher. Although barley is probably the least valuable of the three cereals as a food for laying hens, a fair percentage may be included in the grain ration when the price is reasonable.

Many tests have since been conducted with the system known as "free choice feeding" where the birds are allowed to choose for themselves the foods they wish to eat. The different meals and grains are placed in separate hoppers and are available to the birds continuously. Much valuable information on the palatability of foods has been learned from these tests. Palatability plays a very important part in poultry feeding because the success of the poultry farmer depends very largely on the amount of food his birds can consume and turn into eggs. If the consumption of food is limited because it is unpalatable, egg production will be affected and profits reduced.

It has been noticed that the grains—wheat, oats, maize and barley are preferred to the dry meals—bran, pollard, meatmeal, &c. This factor is inclined to upset the balance of the ration because the grains contain less protein than the meals and for this reason free choice feeding is not generally adopted on the commercial farms. The preference for the different grains is usually in the following order:—Wheat, oats, maize, barley. Many poultry keepers say that their birds will not eat oats or barley, but these tests have shown that even when other grains are available they will still eat a fair quantity. Others say that as oats and barley contain a large percentage of fibre they are unsuitable as a poultry food, but practical tests have proved that these grains are a valuable addition to the ration.

The value of green feed for laying pullets has been clearly demonstrated. Soaked lucerne chaff and sprouted oats were tried as substitutes and no green feed as a control pen. The conclusion drawn from the test was that soaked lucerne chaff and sprouted oats, although better than no green feed, cannot take the place of fresh succulent green feed. Although the surviving birds in the "no green feed pen" laid reasonably well, the death rate was particularly high. This shows the importance of green feed from a health point of view.

Various tests have been conducted with meatmeal and dried buttermilk to see which would give the best results as a protein food. With dry mash, dried buttermilk seems to have given the better results, but with wet mash the difference is very slight. The highest egg yield recorded for a pen—211 eggs per bird—was produced by a pen of 60 White Leghorns which were fed on a dry mash consisting of equal parts by measure of bran and pollard with 10 per cent. of dried buttermilk added. Dried buttermilk certainly adds to the palatability and probably to the digestibility of dry mash.

In a two years' test the pens to which meatmeal was fed showed a greater profit over food cost than those to which dried buttermilk was fed although it was very noticeable that the birds which were given buttermilk laid much better than the others during the autumn and winter, and they certainly came through the moult very much easier. The test showed that it would probably pay to feed dried buttermilk to layers from about February to August, but during the spring and summer months it has little or no advantage over meat-meal—a feed that is much cheaper.

During the last two years, the soaked grain system of feeding has been tested against the usual systems of wet and dry mash. In most instances the birds which were fed on soaked wheat or soaked mixed grain laid reasonably well, but owing to the fact that a large percentage of meat-meal was fed in addition, the cost of feeding was considerably increased. It would be economical to adopt this system of feeding only when the price of grain is low in comparison with the price of bran and pollard.

In reviewing all the tests since 1921 in which approximately 7,000 birds have been used, the most striking feature is that with the many different methods that have been tried and rations that vary considerably in composition and analysis, the egg production has been consistently good. Many contradictions have been noticed but that is to be expected in experimental work.

Although satisfactory production has been obtained from many different rations, it is not advisable to be continually changing the ration, Slight changes may be made from time to time as the price of the different foods varies, but any change should be made gradually.

[*Continued on page 596.*

Garden Notes

By A. W. Jessep, M.Agr.Sc., B.Sc., Dip. Ed., Principal, School of Horticulture, Burnley.

DURING the next two or three months the chief work in the flower garden will be maintenance. The majority of the autumn flowering plants should be planted not later than December. With the warm weather, the hose and hoe should be kept busy. Once the transplanted seedlings are established, water thoroughly, but not too frequently, and as soon as the surface is dry enough stir the first ½ inch or so with a dutch hoe. Do not keep watering without hoeing, or the surface will set very hard. If convenient, put on a mulch of strawy material such as stable manure. This prevents the soil from puddling when watering, and helps to keep the soil at a more even temperature. It also prevents the excessive loss of water, and when walked upon does not consolidate the soil. In addition, it adds to the soil a small amount of plant food.

During December, plant out the main batch of dahlias so that they will flower from mid-February onwards. This will ensure that their blooms will miss the hottest weather. Another planting of gladiolus corms may be made now, and they should flower about the end of February.

It is rather a hot month to sow seeds, but it is not too late to plant quick growing summer annuals, such as cosmos, tithonia, portulacca, and the giant French marigolds.

Plant poppy seeds now so that they will be ready to transplant in February, and flower from May throughout the winter. The majority of people sow poppies much too late to get the best results, as their essential value is that of a winter flower.

Plant out any of the following:—Bearded iris, nerine, pentstemon, zinnia, marigold, and carnation. Nip back chrysanthemums, and do not give them too much water. The wood should be allowed to harden, and the plant disbudded as required. Of the autumn flowering plants, the zinnia is one of the most popular. This is partly because they bloom so freely and flower until the winter. The short flowering period of some of our summer annuals is a serious drawback.

The zinnia varies in size from the dwarf type of 6 inches or so to the tall growing varieties of about 3 feet. The flowers are of many colours from yellow through the various orange tones to deep crimson, and are very attractive both as a garden subject and for indoor decoration.

Zinnia seed requires a medium temperature before it will germinate. For early plantings, sow the seed under glass, and harden it off before transplanting. For the later plantings it is preferable to sow the seed in the open bed in October to December, and transplant when large enough. As the zinnia requires plenty of sun, select a good open position, and throughout the growing period be careful not to overwater. It is better to keep the soil well hoed and mulched and the bed on the dry side, as the stems are prone to rot at ground level if the soil it too moist.

Use the small types as border plants, and group the large types as the massed effect is very attractive. Plant the smaller types 8 inches apart, and the largest ones about 18 inches. The following varieties are well worth growing:—

1. Z. linearis—a dwarf variety with bright orange yellow flowers, very suitable for borders.

2. Z. Lilliput—a dwarf variety of mixed colours, and having roundish flower heads.

3. Z. Haageana—another dwarf variety.

4. Z. Attraction—a large dahlia-flowered type of a reddish hue, and growing to a height of about 2½ feet.

Other large dahlia-flowered varieties include Canary Bird (primrose colour), Lemon Beauty (golden yellow), Scarlet Flame (orange and scarlet); and Crimson Monarch. A new type which is less formal in the shape of the flower is Fantasy, and it is thought that this type will increase the popularity of the zinnia.

Vegetables.

The difficulty in obtaining good vegetables this year should give an impetus to the home gardener to endeavour to grow some for the household use. During this month and next, the chief operations in the garden will be repeating the sowing of salad plants and beans and looking after the other growing vegetables. Lettuces are very useful, and sowing should take place every fortnight, care being taken not to give the plants a set back during growth. Sow in their permanent position, thinning out

and transplanting the extra ones, or using them. Lettuce may be used at any time of their development.

French beans and butter beans remain in bearing for about a month, so make monthly plantings until next February.

Plant out tomatoes for a late crop. If well looked after, they will commence to ripen about two months from the time of transplanting.

Make further sowings of radish, cucumbers, and peas, and plant seed of cabbages and cauliflowers. Stop cutting the asparagus and allow the fronds to develop to provide the crowns with food for next year's crop. Give the bed a light dressing of sulphate of ammonia and water it in.

The celery will require attention, and the early crop will soon be ready for blanching. There are several methods of blanching celery, from the brown paper wrappings in the small garden, to the wooden sides method of the commercial grower. With this latter method, the plants are grown in rows about 9 inches apart and 9 inches between the plants. A board, 1 foot hight, goes around the outside of the bed. The leaves of the plant shade one another, and the board protects the outer rows.

Orchard Notes

By J. L. Provan, B.Agr.Sc., Senior Horticultural Instructor

SHOULD weather, favorable to the development of brown rot of stone fruits, occur during early December, late varieties of cherries and early varities of peaches will require to be protected from this fungous disease. Dessert peaches may be sprayed with a wettable sulphur spray, 4 lb. in 100 gallons, up to fourteen days before picking. If later treatment than this is required in peaches and cherries, an ammonium polysulphide spray, 1 gallon in 80 gallons of water, plus 3 lb. of soft soap, could be applied. Late canning peaches, which were not sprayed at the end of November with a dry-mix lime sulphur, 25 lb. in 100 gallons, should receive an application of this spray early in December. Sprays containing copper or sulphur should not be applied to apricots at this time of the year.

In many orchards, trees are showing a lack of vigor, and the weather conditions have caused the foliage to be rather tender. In this condition the leaves are particularly susceptible to spray injury, and care should be taken to ensure that the water to be used for arsenate of lead sprays is not highly mineralized. Already this season some evidence of arsenical spray burn has been noted on pear trees. This burn takes the form of a light to dark brown area along the margins and at the tips of the leaves, and also, irregular brown spots towards the centre of the leaf. On the young developing fruit the injury takes the form of an irregular depressed, dark-purplish area, frequently horse-shaped. Where combination sprays are used, e.g., lead arsenate and lime sulphur, the addition of a lime casein spreader will reduce the tendency to spray injury.

Provision should be made for the strawing of Gravenstein apple trees and Williams pear trees. Many growers adopt the practice of strawing generally in their orchard, with good results. Not only is the windfall fruit protected, but also the addition of this organic matter is valuable in maintaining soil fertility.

A new packing chart, for the packing of peaches in the Australian long bushel case for interstate markets has been issued and is available free on application to the Department of Agriculture.

Various factors have combined to reduce the setting of fruit this year. Cold and rainy weather was experienced during the blossoming period, and this, undoubtedly, interfered with pollination and fertilization. Some pollen was lost, but the main effect was that the cold windy, and often wet, weather seriously reduced the activities of insects which bring about pollination. There was a noticeably small population of bees in orchards during the spring and this was, no doubt, due to the very unfavorable summer, coupled with a very wet winter. Unfavorable weather can also cause a delay in the growth of the pollen tube after pollen has reached the stigma, and even if pollination occurs, the lack of vigor in the pollen tube would cause a light setting. It was a noticeable feature also that the vigor of the trees had been influenced by the wet winter,

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and although the blossom was heavy, probably too heavy, the growth, at the same time, was rather weak, and indicated a reduced vitality of the tree. It has already been stated, in last month's orchard notes, that the soil nitrate nitrogen was extremely low this spring. Past observations indicate that blossoms frequently fall without setting fruit when this condition exists.

December is an important month in the deciduous orchard, because the elongation of the current season's wood ceases during this month and blossom-bud differentiation occurs. It appears that the date of cessation of growth is a more important factor in productivity of the tree than the total amount of growth, and it has been observed, in some seasons, that growth continues late into the summer, or recommences during the summer, and both these conditions result in the succeeding crop being lighter. Fruit bud formation is markedly depressed if growth continues late into the summer. Shoot elongation of apples and pears usually ceases towards the end of November, or in early December. Differentiation of the buds of Yates, Jonathan, and Cleopatra, into blossom buds, commences about the middle of December, or, in the case of a late blooming variety like Rome Beauty, and also in Dunn's, it may be delayed until January. Modification of buds of Williams pear trees occurs in early December and, therefore, coincides with the cessation of the current season's growth.

Growers who have been in the habit of using copper sulphate to control yabbies in their orchard by placing a small amount of this substance down the tunnels made by them in the soil, should take care that, when the tunnels are close to the trees, only very small amounts of copper sulphate are used. A weak solution is better than applying the crystals to the tunnels. A very weak solution will control yabbies and, as trees can absorb copper through the roots, limbs may be killed if too much is applied. The effect on the tree is to cause the wilting of the leaves and fruit, and the leaves subsequently fall.

Poultry Pests

(Continued from page 574)

turns into the pupal or resting stage, in which it lives from fourteen to sixteen days before turning into the adult flea.

Control.

If a farm has become infested, the following measures are most likely to overcome the trouble.

Affected Birds.—The fleas attack the bare parts of the face, the comb and wattles, which should be dressed once a week with neatsfoot oil. The dressing can be applied economically with a small brush. If neatsfoot oil is not procurable use castor, linseed, or other non-irritating oil.

Disposal of Manure.—The droppings should be removed at least once a week, but more often if possible. If the floor is not paved, an iron tray must be placed beneath the perches to collect the droppings. The fowl manure should be burned, or, if required for fertilising purposes, be placed in a watertight container and covered with water for seven days before use.

Yards and Houses.—The yards, houses, and nests must be kept clean. The yards should be cleaned up once a week and the litter and sweepings burned. It is strongly recommended that the houses should be paved with cement or other impervious material and that the nest be constructed of iron or kerosene tins, raised off the ground and bedded with shell grit or coarse sand. One dressing of quicklime (hot lime) should be given in the houses. Where the floor is of earth, it should be kept, as far as practicable, soaked with water.

Egg Boxes.—Boxes used for packing eggs must be kept clean, must not come in contact with poultry, and must not be stored anywhere near the birds.

Dogs, Cats, &c.—Oil dressings for dogs and cats should be applied to infested areas as directed for fowls, and the kennels and all bedding should be thoroughly cleaned either by scrubbing or boiling, and then exposed to strong sunlight.

Rabbits, rats, and mice should be destroyed and the carcasses burned or buried deeply.

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Victorian Fresh Fruit (Continued from page 560.)

Early season arrivals were mostly very immature and wilted, 100 per cent. severe bitter pit being recorded in one pack.

REINETTE DE CANADA.

Early arrivals of Reinette de Canada generally, included sound fruit free of bitter pit, but one line shipped per *Anchises* to Liverpool was very immature, and showed 60 per cent. of the pack with exceptionally severe pit.

Quality generally was satisfactory.

STONE PIPPIN.

An odd line of Stone Pippins was very green and immature, otherwise condition was good.

Quality good.

COX'S ORANGE PIPPIN.

Only odd lines of Cox's Orange Pippin came under notice. These were mostly in poor condition. Bitter pit was very severe, and there was much waste from penicillium rots.

DEMOCRAT.

The condition of the Democrat variety, generally, was good.

Quality mostly good for grade. Few lines poor quality, severe tree blemishes and spray rust showing in the greater part of the pack.

ROKEWOOD.

Generally Rokewoods outturned in very good condition. There were odd lines in too forward a condition, and a few instances of slight water core, and some water core breakdown was noticed.

Quality.—With the exception of weak to poor colour in many packs, quality was satisfactory. Odd packs included codling, waste from fungal rots, and lenticel spot and blotch. Some very attractive packs of well coloured fruit for this variety were recorded.

YATES.

The general condition of Yates was good. Odd packs towards the end of the season were in poor condition, showing a lot of shrivelled fruit, with many collapsed from penicillium rots following mechanical injuries.

Quality.—While there were many outstanding packs of full coloured fruit in excellent condition throughout the season, it should be noted that this variety was not up to the usual high standard of Victorian Yates. There was far too much fruit showing weak to poor colour. Another defect was "dry stem ring" which was very prevalent this year. It ranged from a few apples in some packs up to 100 per cent. in others, and appeared in the majority of the packs examined. Some merchants reported that this defect had resulted in lower prices for this variety, but I am of the opinion that the defect did not affect values to any marked extent. Instances occurred where buyers returned parcels fearing the subsequent development of rots.

KING COLE, DOUGHERTY, AND BALLARAT.

Only odd lines of the King Cole, Dougherty, and Ballarat varieties came under notice. The condition and quality generally was satisfactory.

Packing and Grading.—Unless reference is specifically made under the comments for the respective varieties, grading and packing was considered to be satisfactory.

Prices Realized.

The market opened in April on a reasonably good level for Jonathans at prices varying from 9s. to 12s., according to size. Some lines in defective condition, and showing waste, sold down to 7s. per case. Prices eased to 10s. per case for the best sizes towards the end of the month. In May, prices advanced 6d. per case, and in early June, when Victorian Jonathans finished, 11s. 6d. to 12s. per case was obtained for sound fruit of good quality. Coloured apples of all varieties were never in excess of demand; in fact, the market was frequently in need of this type of fruit, which was reflected in the steady market level for Jonathans, and the good prices frequently obtained for fruit not considered in the best of condition, or of good quality.

The Granny Smith variety was always a good trade. Opening in April at 12s. 9d. per case for best sizes, up to 15s. per case was made in the middle of the month. Prices continued at 13s. to 14s. for May and June. July saw an increase up to 15s. 6d. when the last consignment from Victoria arrived. End of July and August prices for Western Australian Granny Smith apples reached 20s. to 22s. per case. For the greater part of the Victorian season for this variety there was much immature fruit exported, and this generally was severely affected with bitter pit.

On arrival on the United Kingdom markets up to 100 per cent. severe pit was recorded; 50 to 60 per cent. severe pit in the large 2¾-in. to 3-in. apples was frequently under notice. It says a lot for the opinion which consumers have for this variety, if they are prepared to pay 6d. per lb. for badly-pitted apples. One wonders how long this high appreciation of the Granny Smith apple will continue in face of a continuation of the policy of exporting immature fruit, which not only fails to mature at this end, but which is so seriously affected with bitter pit.

Harvesting pears at Bamawm, Victoria.

Sound, or reasonably sound Cox's orange pippins, free from pit, realized up to 15s. 6d. per case, and severely pitted samples with waste from fungal rots down to 5s. and 7s. per case. Only a few lines, however, were exported from Victoria.

The Yates variety was always a good trade, for the reason that it is a late season coloured variety, which buyers must have, and not for any intrinsic quality in the fruit itself. The condition, as stated earlier, was generally sound and the quality, except for dry stem ring and weak colour, was satisfactory. First arrivals in middle May sold for 9s. 6d. to 10s. Later, small sizes sold down to 8s., and the wanted sizes 2¼ inch and 2½ inch up to 11s.

Always a good demand exists for Rokewoods, for they are recognized as a splendid keeper. Opening at 9s. 6d. to 10s., prices advanced to 11s. 6d. and up to 13s. in Liverpool in early June. The market eased at this time to 9s. to 10s. 6d., and improved again by the end of the month to 11s. 6d. Late July and August prices for Western Australian fruit rose to 15s. per case.

Seasonal range of prices for sound fruit of other varieties was as follows:—Dunns, 8s. 6d. to 12s.; Alfristons, 10s. to 12s. 6d.; Reinette de Canada, 8s. to 9s.; Cleopatras, 9s. to 12s. 6d.; King David, 8s. 3d. to 9s. 6d.; Delicious, 8s. to 10s. 6d.; Rome Beauty, 9s. to 12s. 6d.; and S.T.N., 8s. 9d. to 11s. 6d.

PEARS.

The quantity of pears exported from Victoria to the United Kingdom this year was the lowest for several years. The figures since 1935 are as follows:—

Mostly Flat Bushel Boxes.
(Some Standard Boxes).

1935	319,582
1936	410,443
1937	476,160
1938	351,480
1939	293,096

This season's total of 293,096 cases was consigned to the following ports. In this connection it is gratifying to note that Glasgow received a direct shipment for the first time. Hitherto, Glasgow requirements had been drawn solely from consignments discharged at other ports:—

London	203,997
Liverpool	42,705
Southampton	27,406
Hull	3,322
Glasgow	15,666
	293,096

Hamburg was also the discharging port for one consignment of 8,096 cases.

These pears were shipped in 35 steamers, of which fifteen turned out a very even consignment of hard, sound fruit; in eleven shipments the condition was mostly good, with some lines forward to ripe; and with the balance of nine steamers, the condition was rather variable, probably about equal parts being hard and

sound, and forward to full ripe respectively. The ripe fruit was usually, but not consistently, associated with certain varieties as Packhams, Bosc, Josephines, the latter variety showing by far the greatest quantity in this condition.

Packhams.

The condition of Packhams was good throughout the season, which included arrivals on the first shipment on the 14th March, and the last on the 22nd August. In many shipments the pears were uniformly green and hard, and in others the bulk was in this condition with some lines forward to ripe, and an occasional lot over-ripe and collapsed.

Quality.—Little fault could be found with the quality of Packhams. They were generally well up to grade, clean and attractive, and, with the exception of some small fruit, met a good demand throughout the season. Some packs were not all they should have been, and were below grade with excess tree blemishes, codling and stings.

Beurre Bosc.

The first few consignments of Beurre Bosc pears opened up, generally, in splendid condition. There was an odd line or two full ripe to over-ripe with some collapsed, and there were also a few lines showing much shrivel. Later consignments were most disappointing, with many of the packs in a forward to full ripe condition, and showing serious defects. To give some indication of the quality of fruit affected in this way the following are examples of some of the inspections made:—

(1) 21 brands inspected, 11 good, 10 forward to ripe and wasty.
(2) 14 brands inspected, 6 good, 8 forward to ripe and wasty.
(3) 12 brands inspected, 8 good, 4 forward to ripe and wasty.
(4) 18 brands inspected, 12 good, 4 forward to ripe and wasty.

In some of the later shipments the condition was uniformly good. For example:—

(1) 25 brands examined, all good.
(2) 14 brands examined, all good.
(3) 20 brands examined, 19 good, 1 ripe.
(4) 15 brands examined, all good, except odd waste.

During my six years in England, I have never experienced the Beurre Bosc variety with similar troubles as were outstanding this past season, and one can only suggest that adverse seasonal conditions were the factors causing the trouble. Pears arrived with dry and blackened stalks, frequently associated with rotting of the flesh at either or both the stem and calyx ends.

Many packs also opened up yellow although quite hard and sound, and this condition was also a new experience for me. Good quality Boscs in sound, hard condition, which were kept for ripening tests, failed to ripen satisfactorily, becoming mealy and showing little or no flavour. This variety presented a difficult and worrying time for the trade. Buyers became suspicious of even very good packs in splendid condition, and prices suffered accordingly.

In previous seasons Boscs and Packhams have realized about the same prices on a season's average, but this year Packhams sold at shillings a case better. I am informed that Tasmanian Beurre Bosc showed a few of the defects of the Victorian fruit, and even in comparison with Victorian sound pears kept in better condition after discharge from the ships.

Quality.—Apart from the green-skinned variety, which the trade does not favour as well as the "brown" russety Bosc, and also to the appearance of those with yellow skins, there was no other major defect in quality. Odd lines showed excessive tree blemish, and there were also packed some diminutive pears under the regulation minimum size of 2 inches. As with every other variety of both pears and apples, there were many splendid packs of high grade pears of this variety included in all consignments.

Howells.

Howells arrived in the first shipment on the 14th March and finished by the end of April. Some consignments turned out uniformly hard and sound, and free from the disfiguring case marking which so often spoils the appearance of this variety. Other consignments were rather variable, part being hard and sound, and part forward to full ripe. In the latter, some contact bruising was in evidence.

Quality generally was clean and very good; only odd instances of excessive tree-blemished packs coming under notice.

Beurre d'Anjou.

The condition of Beurre d'Anjou was mostly green hard, odd lines being green ripe. Some defects in condition included fungal rots in green hard pears, apparently due to mechanical

injuries; immature and shrivelled fruit; ripe fruit, and bruised and wasty from fungal rots.

Quality generally good to very good. Some packs, however, included pears with severe blemishes, which were far in excess of the tolerance allowed.

Comice.

Only small quantities of the Comice variety came under notice in about ten shipments. Generally, the condition was hard and good. One line opened up firm to full ripe, and another was immature and shrivelled.

Quality ranged from good to poor, the latter including the greater part of the pack, with severe and excessive tree blemishes. This marked fruit was difficult to sell at 10s. per case, when the market for good clean quality was 15s. to 16s. per case.

It is of interest to note with this variety how some growers, who have good fruit, take the maximum care in grading and packing to ensure good condition and appearance when presented to buyers. Double wrapping of large pears is a valuable precaution against case injury which might well be adopted by growers generally. Josephine, Beurre d'Anjou, Comice, Howells and Glou Morceau are varieties which particularly require the maximum protection, if they are to open up in these markets in good condition.

Josephine.

Each year the Josephine variety is consistent in its inconsistency, for there is no variety exported from Victoria which opens up in such a variable condition. Notes made on the inspection results of one consignment fully support this statement, viz.:—

Green, hard, good condition.
Green, firm, ripe condition.
Green, hard, green-yellow firm ripe, and yellow full ripe mixed.
Green, firm, ripe, and yellow full ripe mixed.
All yellow, full ripe.

These notes refer to different brands inspected in one shipment. Other shipments showed a similar outturn, while others again included the bulk in a green hard sound condition. Such a wide variation in condition might be due, to some extent, to unsuitable cool storage conditions during the voyage, but, it does not explain the wide variation in condition from green hard to full ripe in the same pack. Some packs included a lot of pears severely bruised, particularly in the large sized fruit.

Quality.—Not so good as previous years. There were many packs of clean, good quality fruit, but far too many, which included a fair part of the pack, below grade, with excess tree blemishes. One pack included quite a number of pears with crescent-shaped flesh injuries consistent with damage caused by finger nails.

Winter Nelis.

With the exception of an odd line, which opened up in a forward to ripe condition, the outturn of Winter Nelis pears was uniformly green and hard.

Quality.—This variety also showed the effects of adverse seasonal conditions, as several packs included some rough and misshapen pears and severe excessive blemishes.

A larger percentage of small fruit of 2-in. to 2½-in. sizes was also packed this year, and, in these packs, there were many fruits under the 2-in. minimum. The small Nelis were a difficult problem for the merchant, who was frequently forced to accept as low as 8s. to 9s. per case. At the close of the season, when high prices ruled for pears, small 2-in. fruit made only 11s. as against 22s. for the 2½-in. size.

Winter Cole and Madame Cole.

There were not large quantities of the varieties Winter Cole and Madame Cole in any shipment, but those that did come forward were, generally, in good hard sound condition. Odd lines included some waste from fungal rots. The quality of Madame Coles, which arrived in the latter part of the season, was satisfactory to good, but Winter Coles were rather disappointing as far too many packs included a lot of fruit with severe and excess tree blemishes, so severe, as to make them quite below even "Good" grade, and unfit for export.

Winter Coles also included many packs of small fruit, and there were several instances of fruit being included under the minimum 2-in. size.

Keiffer.

Generally the Keiffer variety arrived in a good hard condition, odd lines were forward to ripe, and included some waste from fungal rots.

Quality was clean and good.

Other Varieties.

Only odd lines of the varieties Broom Park, Black Achan, Glou Morceau, and Winter Bartlett came under notice. Those inspected were mostly good, with the exception of one

line each of Black Achan and Winter Bartlett. The former was ripe and wasty from fungal rots, and the latter was yellow ripe and over-ripe with core breakdown.

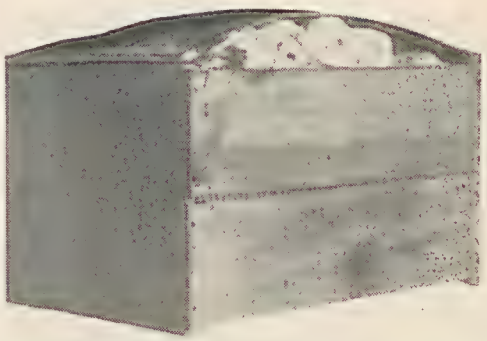
The *quality* of most of these varieties was satisfactory to good, but one line of Black Achan included many rough and misshapen pears.

Packing and Grading.

Taking the season's pack as a whole the functions of packing and grading were satisfactorily carried out by the majority of exporters. In fact, several packs were without fault, and, in finish and presentation, deserved the highest commendation. Detailed reference to these packs has been referred to in the reports on the individual shipments.

One large exporter of pears used the American frictionless packing board for the first time this season. I have followed this particular brand very closely, during past years, and have suggested that the inferior quality board previously used was not doing the job for which it was intended. I have no hesitation in saying that the adoption of the frictionless cardboard has resulted in considerably less case-damaged fruit. Some case marking still occurred at the ends, and this would be practically overcome if the board were included there too.

Slack packed Australian apples on show in a London sales room—1939.



A case of Australian apples showing "commercial bulge," as it is known in London —1939.

Slack Packs.

There was quite a number of instances of slack packs throughout the season. These were due to one of three causes, viz.:—

(*a*) The use of incorrect counts.
(*b*) Faulty grading resulting in the mixing of sizes.
(*c*) Insufficient fruit in the case.

Faulty Grading.

Many instances of faulty grading occurred in most varieties. Typical examples are as shown below:—

(*a*) Packed as $2\frac{1}{8}$ inches, included many under 2 inches.
(*b*) Several lots from 25 to 90 per cent. below the minimum of 2 inches.
(*c*) Faulty sizing—two sizes mixed, as $2\frac{1}{2}$ inches and $2\frac{3}{4}$ inches.

Wrapping Papers.

Wrappers were frequently too small for large sizes and of inferior quality, resulting in torn wrappers and unsightly appearance and case-marked fruit.

Mechanical Injuries.

Many instances of pears, sometimes a few, on other occasions, several pears per case, were recorded with mechanical injuries, resulting in the development of fungal rots. When rots have developed it is difficult to say how these injuries have been caused, but two instances were noted this year, when the cause could be fixed with a fair degree of certainty.

Several growers' pears, packed under one exporter's label, showed small round or almost round holes, which were most probably caused

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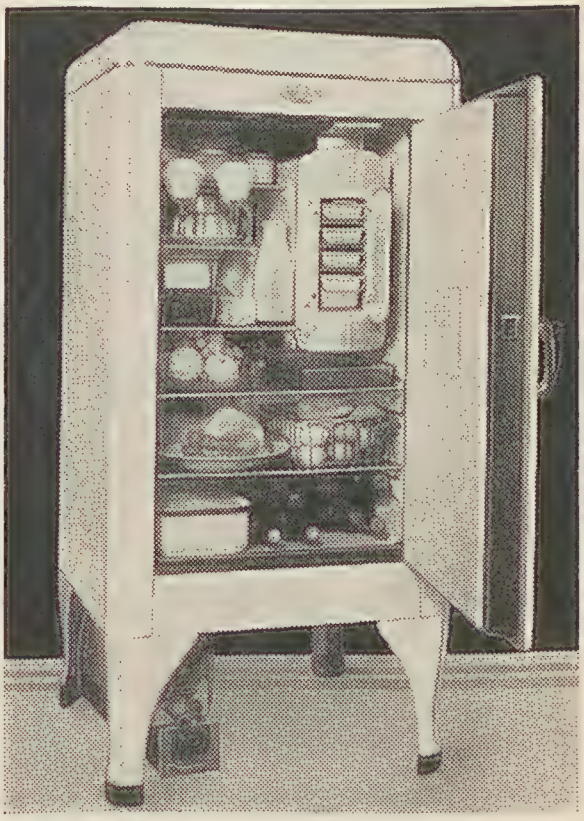

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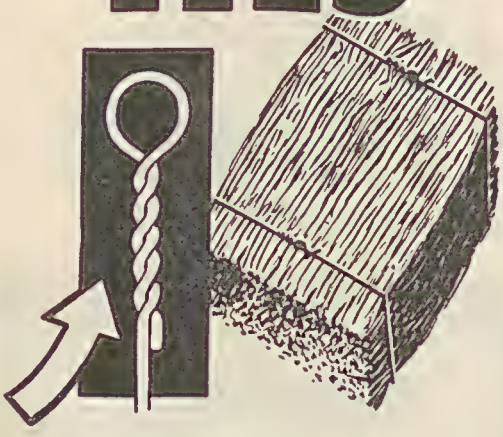

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by a protruding nail head or screw in the grading machine. Four varieties were affected, and some of the injured fruit had commenced to develop penicillium rots. The pears were all green hard on discharge from the ship. The other instance was small crescent-shaped flesh injuries, which were not inconsistent with damage caused by the packers' finger nails.

Regular inspection of packing house equipment, and a close supervision of individual packer's output would appear to be essential to overcome these faults, which cause waste and consequent lower values.

Prices.

The market opened on a fairly good tone with a satisfactory demand for the principal varieties, and continued on a fairly satisfactory level with no outstanding high prices, until the end of the season when over 20s. per case was reached for the popular varieties. Two exceptions to satisfactory prices should be noted. The first relates to the Beurre Bosc variety which, when so much fruit commenced to arrive in a ripe and wasty condition, lost buyers' confidence and were always in slow demand, even for sound parcels at the lower price levels. The second exception was the relatively bigger percentage, in comparison with previous seasons, of small 2-in. and 2½-in. pears of several varieties. This class of fruit has a limited output at any time, and when quantities were increased, the demand failed to respond, and sales could only be made at low values.

The following is a statement of the monthly range of prices realized for sound pears. The principal varieties only have been included. The lowest prices shown, cover the small sizes, and the top prices the popular sizes or counts:—

——	March.	April.	May.	June.	July.
Anjou ..	11/– 13/–	11/6 14/–	12/– 13/6	.. ..	14/– 15/–
Josephine	13/– 15/–	12/– 14/–	10/– 15/–	10/– 17/–	11/– 21/–
Coles ..	..	9/– 9/6	9/– 10/6	8/– 13/–	11/– 14/–
Nelis ..	..	..	8/6 15/–	11/– 18/–	11/– 22/–
Keiffer ..	..	9/– 10/6	8/6 11/–	9/– 13/–	10/– 14/–
Packhams	12/– 14/–	9/6 14/–	11/– 15/–	9/– 18/–	11/– 20/–
Howells	10/– 12/–	8/– 10/–	..	..	..
Bosc ..	11/– 13/–	10/– 13/–	9/– 13/–	9/– 14/–	10/– 14/–

PLUMS.

Two consignments of plums were shipped from Victoria this season. The first comprising 858 half-bushel boxes arrived per s.s. *Melbourne Star* on the 1st March, and was carried at temperatures of 31½° to 33° Fahr. The bulk consisted of the Jefferson and Golden Drop varieties, the balance of the consignment being made up of Satsuma, Diamond, Magnum Bonum, Grand Duke and President.

With an odd exception all varities opened up in a fairly good marketable condition, but all were more or less injected, some slightly, others to a severe extent. Generally, the more immature fruit was less affected than the forward fruit, which included several packs with severe internal browning. Diamonds were particularly bad in this respect and were very soft and showing waste. One lot sold for 3s. per box and another for 8s., the latter price being far above the real value of the fruit. One lot of Wicksons, which sold for 8s. to 10s. per box, was quite brown internally, but was very firm, and this condition enabled a good sale to be made for fruit which would never be satisfactory from the consumers' point of view. Grand Duke and President realized 12s., and some up to 16s., other varieties from 8s. to 9s. per box.

The second consignment per s.s. *Brisbane Star* consisted of plums carried at the usual storage temperature of 32°F. and an experimental commercial consignment of some 1,600 boxes. The shipment of this latter fruit was arranged by exporters, who had been so impressed with results obtained from experiments carried out in Melbourne, where it was found that plums kept for a limited period at a temperature of 32°F. and then raised to 45°F. would keep for several weeks, and subsequently ripen normally without the defects, which have consistently followed each year, when plums carried at 32°F. have arrived in London.

Full reports by Dr. T. H. Harrison, Commonwealth Fruit Officer at Australia House, and myself, on the outturn of this shipment. have been furnished to the Department of Agriculture, and my only object in referring to the subject again is to furnish some figures relating to actual prices realized for the plums carried under the respective temperatures. It has been reported that the commercial consignment would show on the average about 2s. per case more than the experimental lot, but the following statement of prices actually realized by merchants show that the advantage was just over 1s. 3d. per box—8s. 9d. for the ordinary storage and 7s. 5.9d. for the experimental.

There is no doubt that this experimental consignment has shown that plums can be shipped from Victoria to arrive with practically no internal injuries, and to ripen in a normal manner, developing juice and flavour. The plums carried at the 32°F. temperature, with few exceptions, have always developed defects, and it has always been difficult to understand how buyers return each year for this faulty fruit.

I am satisfied that this experimental commercial shipment of plums has shown that the combination temperatures are those at which plums should be exported to this country, and offers the opportunity of establishing the trade on a sound basis. I believe that further experimental shipments carried out in the light of experience gained this season will prove this contention.

The Argentine Ant

(*Continued from page* 562)

A suitable poison bait container.

some such material, and then placed near the ant trails. These containers should be distributed every yard or so, particularly near the foundations of the buildings. These cans should be refilled with syrup, if necessary every ten to fourteen days. All the cans should be set out at one time so that the effect of the poison on the ants will be intensified as quickly as possible. It is advisable to move the cans—if only a few feet—once a month, for, should the ants become sick, they may not return to cans situated in the same place.

It must be remembered and impressed upon children that this poison bait is *poisonous to human beings and animals also,* and must be kept out of the way of irresponsible persons and out of the reach of young children.

While the poison baits are in operation early in the control campaign, it will assist in the general clean up if areas inside the houses where the ants are abundant are sprayed thoroughly and regularly with one of the commercial fly spray preparations.

It has been the experience of American investigators that the usual tartar emetic bait as used for other ants is not entirely satisfactory against the Argentine ant.

Control of this pest appears to be easiest in the spring and autumn, the problem being much more difficult during mid-summer because then the colonies are stronger and more scattered and other materials act as counter attractions to the poison baits.

Other methods, consisting usually of the direct application of liquid to the nests of the ants in the soil, are feasible only in small areas as around the foundations of a house and in the garden, since the nests are usually small, numerous and hard to find. Materials chiefly used are carbon bisulphide, creosote, or kerosene. As the Argentine ant prefers situations where leaves have accumulated, leaf debris must be removed.

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Eckert, J. E., and Mallis A. *Ants and Their Control in California.* Calif. Circ. 342, July, 1937.

Smith, M. R. *Distribution of the Argentine Ant in the United States and Suggestions for its Control or Eradication.* U.S.A. Circ. 387, May, 1936.

Professional Papers

[This section is devoted to professional papers and articles of a scientific character.]

The Influence of Nutrition on the Reaction of Wheat to Urocystis Tritici Koern—Part III.

By C. R. Millikan, M.Agr.Sc., Plant Pathologist

(Parts I. and II. of this paper appeared in the June and July issues of this Journal.)

Symptoms and Effects of Unbalanced Nutrition.

DURING the progress of the sand culture experiments at Burnley data were obtained regarding the symptoms of unbalanced nutrition, and its effects on the mineral composition of the plants, brief notes on which are given below. Various workers have described the effects of similar treatments in a wide variety of plants.

Nitrogen Deficiency.

Germination under conditions of nitrogen deficiency was apparently normal. Six days after germination the plants were noticeably backward and spindly. The development of these symptoms occurred earlier than those recorded by Hamner (13) in wheat due to nitrogen deficiency.

The plants were a fortnight behind the controls in developing to the two-leaf stage, when they were a paler green colour than normal—a general chlorosis. The general growth of the plants was the poorest of any treatment studied, and the plants were stiff and erect in habit, with an absence of tillering (Fig. 6). The chlorosis also became very marked.

Within a month of heading, many of the basal leaves of the plants commenced to die. The date of appearance of the ears was the same as that of the controls. Borodina (3) on the other hand has shown that nitrogen deficiency hastens the earing stage in barley and millet. The heads produced were the smallest of all treatments and contained ill-developed grain (Fig. 7).

Nitrogen deficiency caused a marked reduction in the growth of the roots, which were only half the length of the control and not very branched. They were white in colour in contrast to a yellowish tint which occurred in the roots from all other treatments. The general growth of the roots was the poorest of any treatment (Fig. 8).

As regards the mineral composition of the plants, this treatment led to a decrease in the absorption of lime, magnesia, phosphoric acid, and potash in the aerial parts of the plant. The nitrogen percentage was unchanged, indicating the probability of a minimum nitrogen requirement for growth. Richards and Templeman (25) found that although nitrogen deficiency markedly reduced the nitrogen level of barley leaves in their experiments, there was little evidence of a departure from the normal protein cycle. Gregory and Sen (12) however, have shown that nitrogen deficiency is accompanied by a marked reduction in protein and amino nitrogens. The sugar content of barley leaves was greatly increased and was associated with a marked reduction in the respiration rate.

In the case of lemon leaves, where insufficient nitrate was available and growth was retarded, Foot and McElhiney (8) found that boron accumulated in the leaves. Hormone production in Helianthus has also been found by Avery et al (1) to be proportional within limits to the nitrate supply in the nutrient solution.

Phosphorus Deficiency.

Up to the third leaf stage (about two or three weeks after germination) the phosphorous deficient plants were almost as vigorous as the controls in growth. From that stage, however, growth became backward and spindly. While in the third leaf stage, and about five

weeks after germination, the plants developed a copper-coloured marking on the sheath of the third leaf. This symptom persisted for several weeks and then disappeared. The spindly character of the plants and their very erect habit of growth became more marked as the experiment proceeded, while leaf production was reduced, the leaves being thinner than normal in comparison with their width. No tillering occurred, indicating low meristematic activity (Fig. 6). Brenchley (4) records similar symptoms in barley. The colour of the plants became a darker green than normal, i.e., a condition of hyperchlorophylly. Similar symptoms due to a deficiency of phosphorus have been described by Merkenschlager (19) in corn plants, and by other workers.

The date of appearance of the ears was the same as that of the control, but the size of the heads was much reduced. Although larger than the nitrogen-deficient series, they were inferior to all other treatments. Root growth was very inferior to that of the controls (Fig. 8) both as regards length and branching.

Decreases in the percentages of potash, nitrogen, magnesia, and iron were associated with a deficiency of phosphorus in the plant. The manganese content of the plants was increased while a very large increase in the zinc content of the plant also occurred (Tables II. and IV). This latter change is of interest in view of the relation suggested by West (35) between the occurrence of zinc-cured mottle leaf of citrus and the continued application of phosphates. There was a slight increase in the absorption of lime in the 1936 experiment, but no such change occurred in 1937.

Phosphorus deficiency has little effect on respiration (11, 15) but has an important influence on nitrogen metabolism. Richards and Templeman (25) found that protein synthesis was reduced, there being a very characteristic increase in amino nitrogen resulting in decreased meristematic activity. Foreman (9) has shown that proteins occur

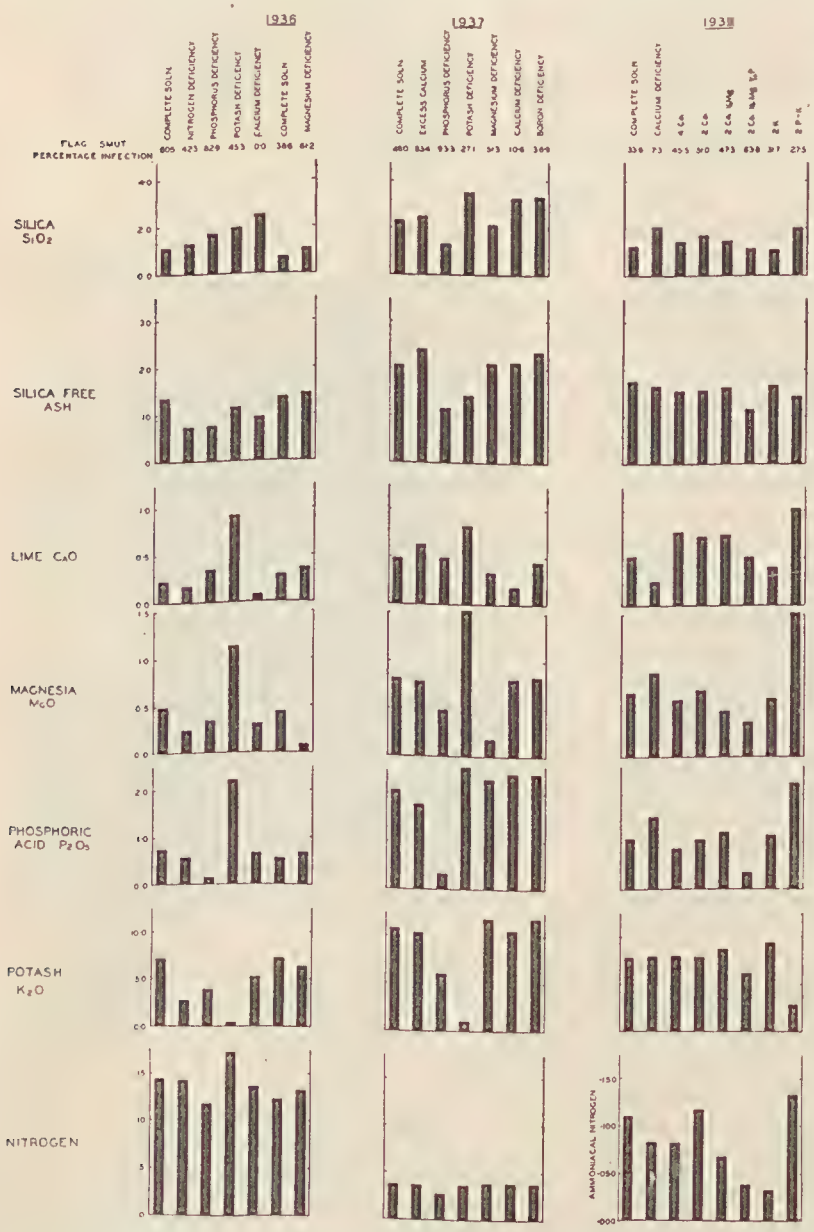

Fig. 5.—Results of analyses of plants, as percentage on dry basis, from flag smut sand culture experiments Burnley, 1936 to 1938, shown in Tables I, II, and IV. Variety Free Gallipoli.

Fig. 6.—Showing the effects of deficiencies of certain elements on the growth of wheat. A. Complete solution. B. to E. Deficiencies of:—B, nitrogen; C, phosphorous; D, potassium, and E, calcium.

in the protoplasm of *Lolium perenne* as "greater complexes" which are associated with phosphorus substances.

An increase in the amount of reducing sugars in phosphorus deficient wheat plants as compared with normal plants has been recorded by Jones (15).

Potassium Deficiency.

In the potassium deficiency test the germination was normal, but the plants were somewhat backward in developing the second leaf, although they were ahead of the nitrogen-deficient plants in this regard. Approximately six weeks after germination when the plants were in the third leaf stage the leaves began to show signs of chlorosis in the form of a broad streak on one side of the mid ribs. Within a few days a second streak appeared on the other side of the mid ribs of the leaves and the chlorotic areas became very distinct. They were most noticeable on the lower half of the leaf (Fig. 9).

The plants became sprawling in habit due to free tillering and bending of the stalks. A knee bending of the stalks of wheat has been found by Sibilia (28) to be associated with a low potash content in the plants, while Gregory and Richards (11) have shown that tillering is normal in potash-deficient barley plants, with the result that the deficiency within the plant becomes very acute. Approximately nine weeks after germination the lower leaves began to die. This early dying of the leaves soon became very marked leaving the stems relatively bare. Richards and Templeman (25) have described the early dying of barley leaves due to potash deficiency. The general height of the plants was slightly inferior to the complete solution plants (Fig. 6). Some of the young leaves produced just prior to heading, showed a type of chlorosis similar to that which developed in the plants receiving excess calcium. After heading the chlorotic streaks in the leaves became less pronounced. The date of appearance of the ears was the same as that of the controls but the heads were reduced in size (Fig. 7). The root development of the plant was also much reduced (Fig. 8).

Fig. 7. Showing effects of deficiencies of certain elements on size of wheat heads. A, complete solution; B. to E, deficiencies of nitrogen phosphorous, potassium and calcium, in that order.

This treatment induced very marked changes in the mineral composition of the plant. The low potash content was associated with large increases in lime, magnesia, phosphoric acid, iron and zinc. The nitrogen concentration was also increased in the 1936 experiment, but a decrease was recorded in 1937. Similar effects of potassium deficiency on the composition of wheat have been recorded by McCalla and Woodford (18).

The effects of potassium deficiency on the respiration and nitrogen metabolism of plants have been the subject of considerable research by different workers. One of the first effects of potassium deficiency is is an accumulation of nitrates and carbohydrates, and an immobilization of amino acids (22). Following this initial stage there is invariably a marked decrease in the content of sugars and starch (12) associated with a greatly increased respiration rate (11). Amino and amide nitrogen also shows a marked increase (25). There is no proof that the synthesis of protein in the plant has any direct relation to potassium.

Calcium Deficiency.

The first symptoms in the plants grown under calcium-deficient conditions appeared in the early third leaf stage, three weeks after germination in the form of chlorotic streaks between the veins of the second leaf (Fig 10). These streaks were most obvious at the base of the leaves, while the distal portion of the leaf often remained comparatively green at this stage. Soon after the first appearance of chlorosis (at about four weeks after germination) a spiral deformation occurred in some of the young leaves while still enclosed in the sheath. Emergence of the leaf was checked, and continued growth pressure crushed a considerable length of the leaf into a close spiral. Later the distorted region emerged from the sheath. Trelease and Trelease (33) have stated that this injury is due to excess magnesium rather than to calcium deficiency. It becomes more severe as the Mg/Ca ratio increases.

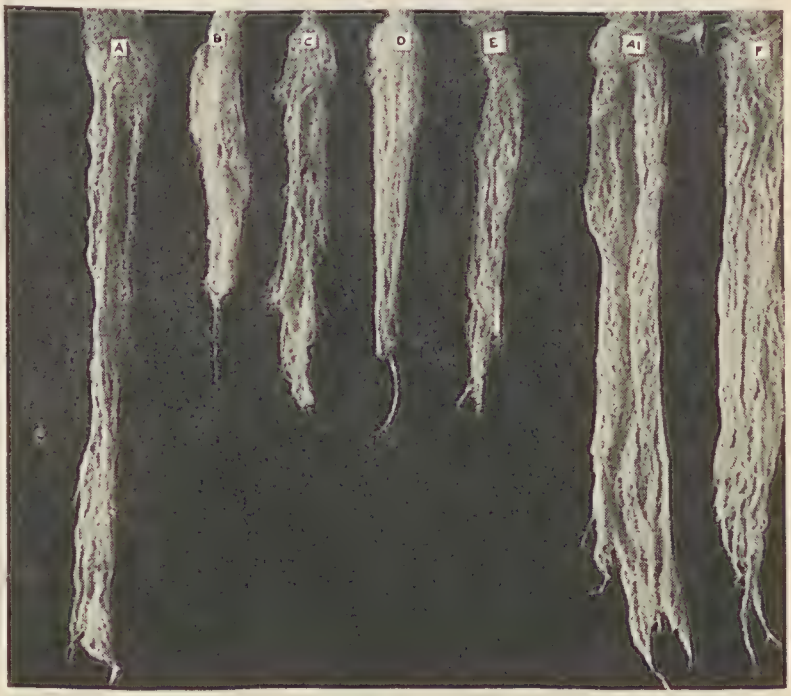

Fig. 8.—Showing the effects of the deficiencies of certain elements on the root development of wheat. A, A1 complete solution; B to F, deficiencies of nitrogen, phosphorus, potassium, calcium and magnesium in that order.

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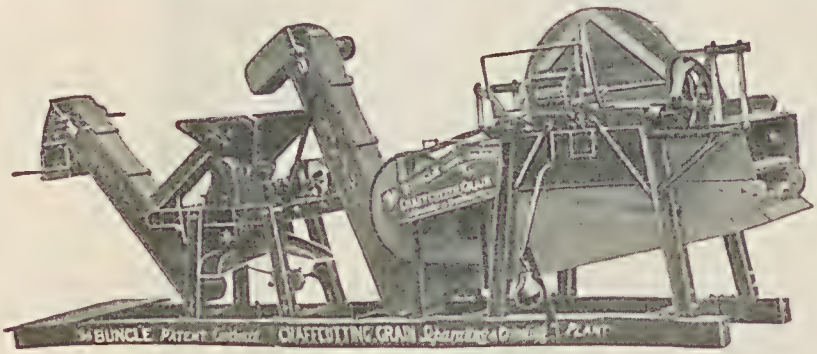

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Marked twisting also occurred in the tips of the leaves (Fig. 11). This symptom frequently became very severe and was sometimes associated with a breaking of the margins of the leaves. The chlorosis at this stage was also marked (Fig. 9) but tended to disappear as the leaf aged. Chlorotic symptoms were not so severe after heading as before heading. The leaves of the calcium-deficient plants were broader than normal in comparison with their length. Nightingale (22) has also recorded that calcium deficiency is associated with injury to young rather than to mature tissues.

Tillering was common, and the general height of the plants at the end of the season was three to four inches less than those receiving the complete solution (Fig. 6). The date of heading was one week later than that of the control plants, and the heads produced were reduced in size (Fig. 7).

Root development was much reduced compared with the complete solution plants. The roots were also darker in colour than those from all other treatments (Fig. 8).

In the aerial parts of the plants the calcium content was very low in the 1936 experiment.

Fig. 9.—Symptoms of potassium (two leaves at right) and calcium (left) deficiencies in wheat leaves. Note the increased width of the calcium-deficient plant.

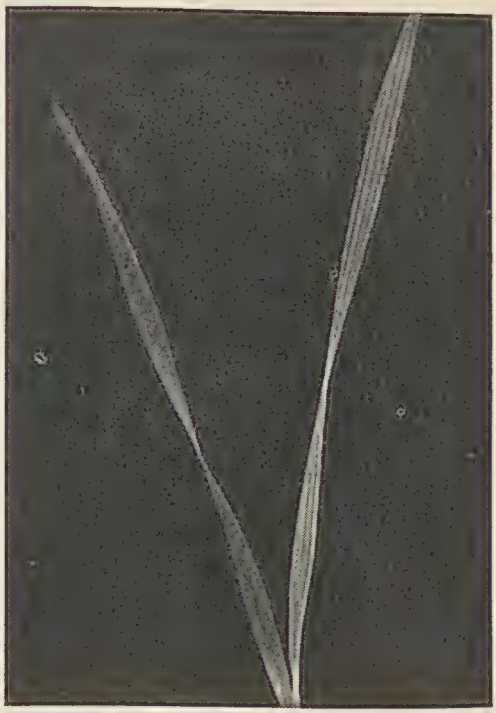

Fig. 10.—Early symptoms of calcium deficiency in the second leaf of the young wheat plant. Note the interveinal chlorosis on the lower half of the leaf.

Decreases in the concentration of magnesia, potash and phosphoric acid also occurred in that year. In 1937, with a higher lime content in the plants no change occurred in the magnesia content, while the phosphoric acid content was increased. Calcium deficiency was also associated with a decrease in the ammoniacal nitrogen content of the plants.

Little is known of the function of calcium in plants. While the plant possesses the capacity to re-utilize its nitrogen, phosphorus, potassium and magnesium to a large extent the work of Petrie (24) has shown that calcium is much less mobile in the plant. He found that it was stored as calcium oxalate and as "combined calcium" in combination with proteins and other materials. Calcium accumulates in the leaves and does not readily migrate from them again.

In calcium deficient plants nearly 100 per cent. of the calcium was found to be water insoluble and principally occurred in the older tissues of roots and tops. Dying of the root and stem tips occurred even though considerable amounts of combined calcium and calcium oxalate were present in the older tissues. A relation between the boron and calcium intake

in the plant has been found to exist, by Odelien (23), a deficiency of the former element being associated with a 20 per cent. increase in the uptake of calcium.

Magnesium Deficiency.

During the whole of the season, the growth of the plants receiving the magnesium deficiency treatment was only slightly inferior to the control plants both as regards height and tillering. Approximately four weeks after germination a series of chlorotic spots developed on the lower half of the first leaf. In some cases these spots later became necrotic and ashen grey in colour (Fig. 12). These symptoms resemble grey speck related to manganese deficiency (26) and have been described by Jessen (14) on barley due to magnesium deficiency. Symptoms on the later leaves were not so marked as these, and can best be described as a mottled chlorosis or a series of faint chlorotic spots along the length of the leaf. These chlorotic spots were interspersed with normal green areas. More severe symptoms of general chlorosis and retarded growth under field conditions have been attributed by Taylor and Howatt (32) to magnesium deficiency. Stieltjes (30) has also described a "tigering" of the leaves of oats related to a deficiency of this element in newly-reclaimed acid soils in Holland.

However, symptoms of magnesium deficiency or Hooghalen disease of cereals in Holland have been shown by van Itallie (34) to be affected by the ratio of the magnesium ion to the others present in the soil. They are accentuated by applications of potash and sulphate of ammonia.

The date of appearance of the ears was slightly later than that of the controls. The heads produced were also only slightly inferior to those on the complete solution plants (Fig. 13). As in the case of the tops, the root development of these plants was excellent, and very similar to the controls (Fig. 8) both as regards length and branching.

The analyses of the plants showed that while the magnesia content was low, this change was not accompanied by any marked alterations in the other mineral constituents in the plant. A slight decrease in the concentration of potash occurred in 1936 while an increase took place in 1937. Opposite changes to these occurred in the lime concentration in these two years. Increases in phosphoric acid and nitrogen however were recorded in both years.

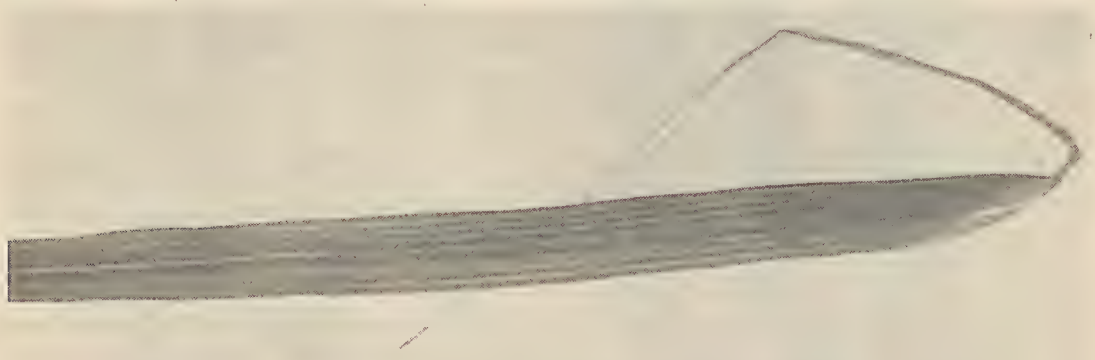

Fig. 11.—Calcium deficiency symptoms in wheat showing the characteristic dying of the tip of the leaf.

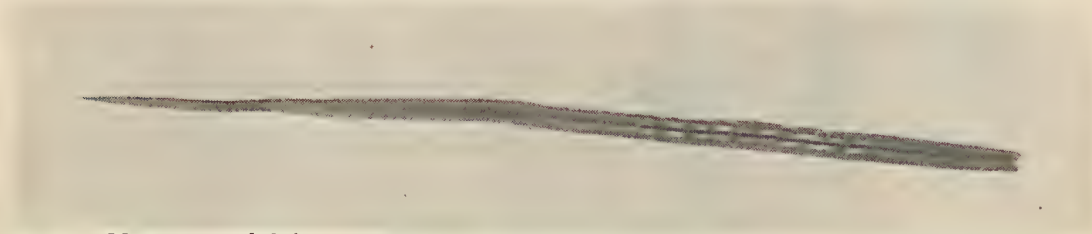

Fig 12.—Magnesium deficiency symptoms in leaf from young wheat plant. Note the necrotic areas on the lower half of the leaf.

Fig. 13.—Showing the effects of magnesium deficiency in wheat on the size of head produced. A, complete solution; F magnesium deficiency.

Magnesium has been found to be related to the chlorophyll production of plants. In the complete absence of magnesium Lutman and Walbridge (17) observed that chlorosis appeared in millet and the chlorophyll bodies were smaller in size and fewer in number than normal. Magnesium was found to accumulate in the younger leaves—the older leaves being almost destitute of it. Only one-tenth of the magnesium in the plant occurred in the chlorophyll.

Little is known of the function of magnesium in the plant other than its effect on the chlorophyll content. Evidence by Fleischer (7) indicates that this element has some role in photosynthesis in addition to its effect on the chlorophyll content.

Boron Deficiency.

The treatment of boron deficiency had no observable effect upon the growth of the wheat plants in 1937, up to the heading stage. As the experiment in that year was terminated at this stage it was not possible to observe the effects of this treatment on the later stages of growth. Shkolnik (27) and Bertrand and de Waal (2) have found that cereals require less boron for normal growth than most other types of plants.

Excess Calcium.

The growth of the plants receiving excess calcium was normal as regards height and tillering, but a characteristic feature was the development of an interveinal chlorosis similar to that resulting from a deficiency of calcium. This was first noticeable approximately five weeks after germination. Dying of the younger tissues did not occur, however, as in the calcium deficient treatment.

The lime and iron contents of the plants were increased by excess calcium nutrition, while decreases were recorded in the phosphoric acid, potash, magnesia, and ammoniacal nitrogen percentages.

Excess Potassium.

A slight interveinal chlorosis, first noticeable in the fifth leaf, developed in the plants treated with excess potassium. Tillering was also reduced. The date of ear production was not affected by the treatment. The phosphoric acid content of the plants was increased, and decreases in the percentages of calcium, magnesium, and ammoniacal nitrogen occurred.

2 Ca ¼ Mg.

The treatment 2Ca ¼ Mg. produced a very vigorous type of growth. The leaves were slightly broader than normal and numerous tillers were produced. Compared with the control plants no difference in date of earing occurred, but the ear stalks had a tendency to be thicker than normal. The concentrations of potash, and to a lesser extent, phosphoric acid, were increased in the plants, while the ammoniacal nitrogen was decreased by this treatment.

2 Ca ¼ Mg $\frac{1}{10}$ P.

The symptoms of phosphorous deficiency, viz.—erect growth, narrow leaves, absence of tillering and hyperchlorophylly were evident in the plants receiving the 2 Ca ¼ Mg $\frac{1}{10}$ P. treatment. In contrast with the effect of phosphorous deficiency, however, this treatment caused the ears to appear eight days earlier than the controls. Marked decreases occurred in the following constituents, magnesia, potash, phosphoric acid, lime, and ammoniacal nitrogen. With the exception of its effect on the

lime content of the plants, these changes are similar to those recorded for phosphorus deficiency.

2 Ca $\frac{1}{4}$ Mg 2N.

In contrast with the 2 Ca $\frac{1}{4}$ Mg treatment, the vigour of the plants receiving 2 Ca $\frac{1}{4}$ Mg 2N was much reduced. They showed a tendency to be spindly and the tillering was below normal. The date of earing was similar to that of the controls.

The magnesia, ammoniacal nitrogen and, to a lesser degree, the potash contents of the plants were reduced, while the calcium, zinc and phosphoric acid concentrations were higher than normal.

2P-K.

Very severe symptoms of interveinal chlorosis developed in the plants under the 2P-K treatment. The injury was more marked than that which occurred under normal potassium deficiency. The chlorosis was first noticeable in the fourth leaf. Early dying of the leaves occurred. The date of earing was normal.

The analyses of the plants showed that marked increases occurred in the calcium, magnesia, phosphoric acid, and ammoniacal nitrogen contents of the plants, while the potash content was very appreciably decreased. This result is similar to that recorded for normal potassium deficiency.

Summary.

Experiments are described which were designed to investigate firstly the effect of mineral nutrition on the development of flag smut in wheat, and secondly, to determine if any changes in the mineral composition of the plant could be correlated with the alteration in its flag smut reaction resulting from the mineral treatment applied.

Sand culture experiments were conducted under greenhouse conditions and field mineral treatment experiments, designed to be complementary to the greenhouse work, were sown in various parts of Victoria. In the sand culture experiments unbalanced nutrition was found to exercise a profound effect on the reaction of the susceptible variety Free Gallipoli to *Urocystis tritici*. A deficiency of calcium in the plant resulted in a very marked reduction in the development of the disease. If the degree of deficiency of this element was sufficiently great the disease was completely inhibited.

Deficiencies of nitrogen and potassium resulted in decreases in the disease, which, however, were not so marked as that associated with calcium deficiency.

Phosphorus deficiency resulted in a significant increase in the severity of flag smut in the plant, while a deficiency of magnesium had no effect on the disease.

The addition of twice the normal amount of calcium to the nutrient solution significantly increased the severity of the disease, but the addition of four times the normal amount of calcium had no significant effect. Excess of potassium, or excess of phosphorus in conjunction with potassium deficiency had no effect on the disease. The severity of the disease was markedly increased by supplying calcium, magnesium, and phosphorus, in the following amounts as compared with the complete solution 2 Ca $\frac{1}{4}$ Mg $\frac{1}{10}$ P. From chemical analyses of the plants it was possible to relate the above changes in the reactions of the plants to *Urocystis tritici* with changes in their calcium content induced by the mineral treatments. An optimum concentration of calcium in the plant under the conditions of any experiment, was indicated. Increases above or decreases below this optimum concentration, reduced the severity of the disease.

The addition of excess calcium (particularly if accompanied by a reduction in the magnesium content of the solution) to plants of the resistant Ghurka variety tended to lower their resistance to the disease. Phosphorus, potassium, or magnesium deficiencies, and excesses of potassium and nitrogen had no effect on the disease reaction of this variety. None of the treatments applied to the Ghurka plants increased their flag smut susceptibility to a point where it was in any way comparable with that of the susceptible control plants grown under the same conditions. In the case of this variety, the relation between calcium concentration and smut reaction is indicated, but further evidence is necessary before it can be definitely established. An observation indicated that the development of powdery mildew (*Erysiphe graminis*) was much reduced by a deficiency of phosphorus in the plant. Deficiencies of other minerals had no effect on this disease.

Considerable variations in the reaction of the susceptible variety Free Gallipoli to flag smut under field conditions were induced by various

soil treatments in experiments conducted during the years 1933 to 1938. These differences in disease reaction were correlated with differences induced in the calcium contents of the plants by the soil treatments. Under the conditions of any particular experiment an optimum concentration of calcium in the plants for the development of flag smut occurred at nine weeks after germination (six weeks in one experiment). This period is considered critical in the development of flag smut as sori consistently first appeared in these field experiments at approximately eleven weeks after germination. This demonstration of an optimum calcium concentration at one stage in the development of *Urocystis tritici* in the plant under field conditions provides confirmation of the results of the sand culture experiments conducted in the greenhouse at Burnley.

The actual value of the optimum calcium concentration varied in the several experiments. The conditions under which the plant grows affects its normal calcium requirements and hence the optimum concentration.

Comparative tests on the effects of certain soil treatments on the flag smut reaction of the susceptible variety Free Gallipoli and the resistant variety Ghurka indicated that the degree of resistance possessed by a wheat variety determines whether such treatments will affect its flag smut reaction. The resistance of Ghurka was significantly increased by a soil treatment which had no effect on the disease reaction of Free Gallipoli.

Symptoms of unbalanced nutrition in wheat, and its effects on the mineral composition of the plant, are discussed. Of particular interest is the very large increase in the zinc content of the plants which accompanied a deficiency of phosphorus.

Acknowledgment.

It is obvious that the investigations reported in this paper are largely dependent on results of a considerable number of intricate chemical analyses, all of which were conducted in the agricultural section of the State Laboratories, under the general direction of the Agricultural Research Chemist, Mr. W. R. Jewell. The author is very pleased to acknowledge his indebtedness for this phase of the report and for the general help and criticism afforded him, at various stages of the investigation, by Mr. Jewell.

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(*Continued from page* 576)

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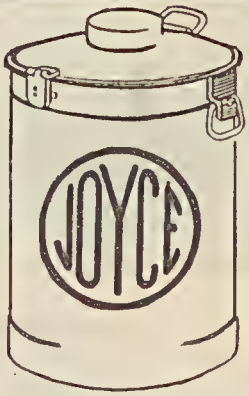

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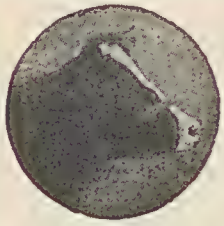

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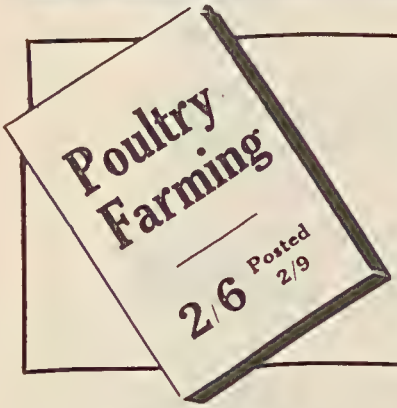

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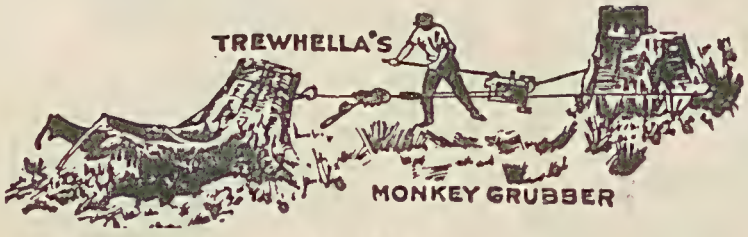

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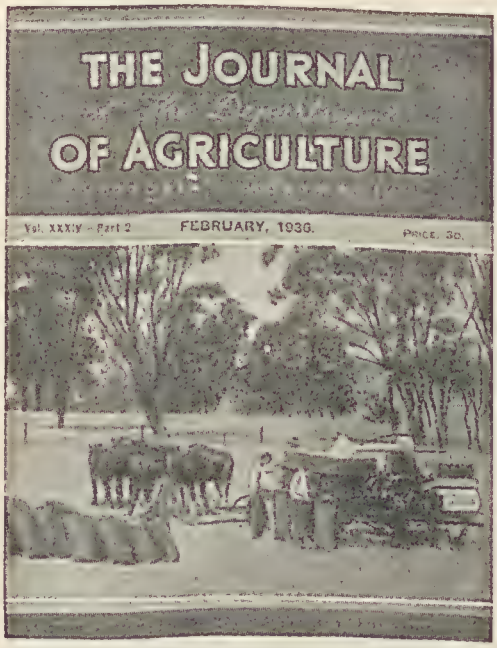

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